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A Soil Erosion Control Experiment.

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Edited by
J. F. F. REID
Associate Editor
C. W. WINDERS, B.Sc.Agr.

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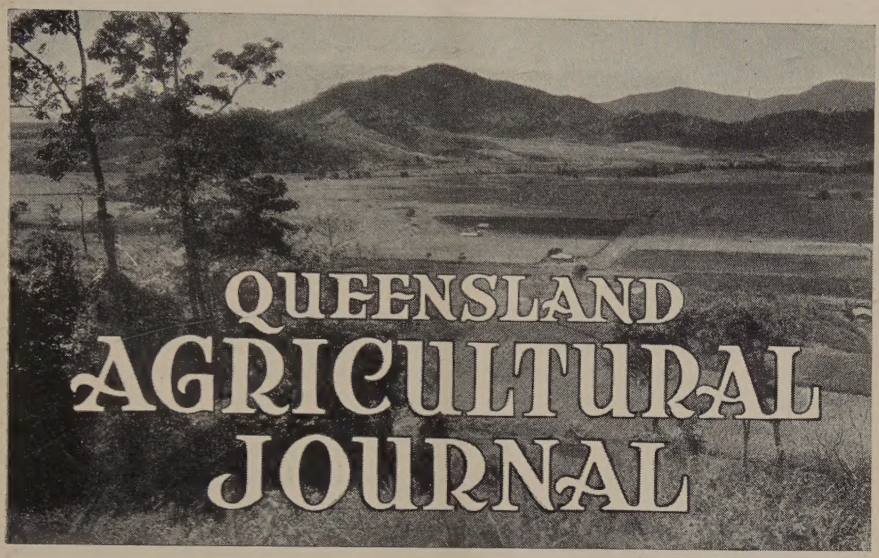

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Event and Comment.

Beef for Export.

ASSURANCES that the Queensland Government will assist in the further development of the beef cattle industry in every practicable way were given by the Premier, Hon. E. M. Hanlon, at a recent gathering at the Brisbane Abattoir. When prices were high, said the Premier, there was an obligation on those engaged in beef production to use a proportion of their increased returns for the further improvement of the industry.

Mr. Hanlon went on to controvert the view that Australia would have no beef for export by 1960. If that happened, he said, we did not deserve to hold this continent. There were vast tracts of country almost unoccupied and on which nothing had yet been done by human hand. To suggest that was the best we could do with the immensity of the land available was to give expression to a defeatist attitude from which ruination would be the outcome. There were assured outlets for all the meat we could produce. A colossal market could be developed as a result of improved living standards in countries such as India and China. If the teeming millions of Asia and underfed Europe did not get food they could destroy the world. "I hope to hear no more of this talk of there being no beef for export," Mr. Hanlon added.

Continuing, the Premier remarked that the findings of the Abattoir Commission, confirmed by the Bureau of Industry and backed up by informed people, indicated that there were immense possibilities for increasing the output of the Cooper Channel region and the fattening areas between Clermont and Charters Towers. The great Burdekin dam would provide water for hundreds of thousands of acres of irrigated pastures for cattle fattening. The Queensland Government held the view that the beef cattle industry was of the greatest importance, and would do whatever was necessary to improve the cattle breeding and fattening country, so that by 1960 they would be all laughing at the crazy theory that there would be no more beef for export.

The Film and the Farmer.

WE have had an opportunity of seeing something of the activities of the Mobile Film Unit of the Department of Agriculture in Victoria, which is an integral part of its field organisation. All the work, including scenario writing, direction and technical production, is done by the personnel of the unit and pictures already made and in circulation compare favourably with commercial films in respect of subject, presentation, technical accuracy, photography, and general treatment.

The farmer to-day is more than ever willing to accept and apply the principles of agricultural science. His business acumen impels him, but, what is more important, science is not being rammed down his throat; and he knows that the results of research are put through the test of practical farming before they are recommended for his adoption. There is a marked desire to know the how, the why, and the wherefore of things and, without going into his paddock, there is nothing better in the way of imparting advice and instruction than showing the farmer a good picture illustrative of the information it is desired to convey. Obviously, the film has a big future in this technical advisory field. For example, take the picture "The Science of Milk Production," and its supporting feature "Dairying in Other Lands," now going the rounds in our dairying districts. To see such films is to appreciate the value of this form of visual education.

Moreover, nothing can equal a well-produced and technically accurate presentation of a farming subject for making people generally —people of our towns and cities who, perhaps, know little of country life and industry beyond what may be seen from a motor-car in a rapid run along a bitumen road—aware of their close and vital relationship to the primary producer. Films of our land and water resources, of farming practices and manufacturing processes in respect of primary products, and of social aspects of food and agriculture—all convey lessons which should not be lost on city dwellers and workers in urban industries. To farmers particularly, pictures showing correct land use, new cultural methods with modern machinery, applied principles of soil and water conservation and practical forestry are invaluable. On the screen we have seen how, in older lands, soil worked for a thousand years and more and nursed and nourished by generations of farmers is to-day giving a better product for less labour than in any period of its history. That is what tradition means to farming.

The film may teach us, too, how the food-giving value of the soil depends on care and intelligence and the efficiency of the means by which it is preserved.

A Soil Erosion Control Experiment in the Isis District.*

L. G. VALLANCE.

Introduction.

A SERIOUS problem in the utilization of hill sides for sugar cane culture is the gradual decline in production brought about by the downhill migration of surface soil. In the Isis area there is abundant evidence of considerable deterioration in soil fertility on the steeper slopes of many of the hillside farms which are typical of this district. Some of these slopes have been so affected by erosion that the point is now being reached beyond which they can no longer be profitably planted to cane. Fortunately, however, only a few small marginal areas have, as yet, reached this stage, and even on these it would appear that the wartime scarcity of fertilizer has also contributed to their abandonment. In general, the amount of damage which has already been done is revealed by the poor growth of cane on the upper portions of the slopes as compared with the much more vigorous growth at the bottom. Plates 95 and 96 show a typical eroded hillside in the vicinity of Childers, which is the business centre of the Isis district. In the middle distance (Plate 95) is a slope of 10 to 16 per cent. gradient which has been considerably affected by "sheet" and "finger" erosion. The block of cane (Plate 96) immediately joins this on the right. The upper portion of this block shows the thin stand of cane characteristic of washed soils. The light patches above this indicate the exposed subsoil.

Climate and Soils of the District.

Rainfall figures recorded at Childers are given in the table below, and these indicate a well marked seasonal distribution, with a summer

RAINFALL DATA FOR CHILDERS.

—	Years.	Jan.	Feb.	Mar.	Apr.	May	J'ne	July	Aug.	Sep.	Oct.	Nov	Dec.	Annual.
Rainfall (points)	43	727	669	465	282	207	245	170	119	179	276	274	571	4,184
No. Wet Days	43	10	11	11	9	7	7	6	4	4	6	7	11	—

* Paper presented at the Bundaberg Conference, Q.S.S.C.T., April, 1946, and reprinted from *The Queensland Cane Growers' Quarterly* (Bur. Sug. Expt. Stns., Dept. Ag. & Stock, Q.), Jan., 1947.

Plate 95.

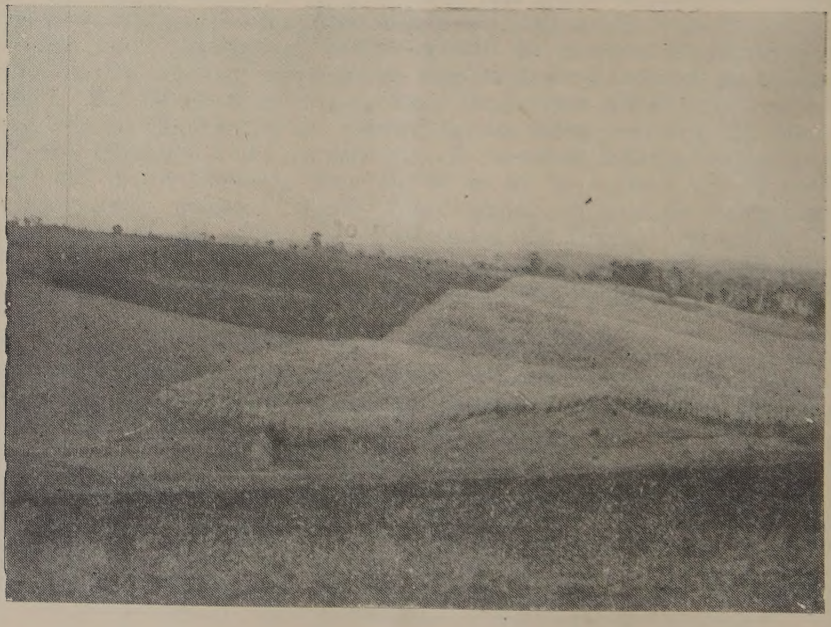


Plate 96.

GENERAL VIEW OF TYPICAL ERODED HILLSIDE AREA.—Showing fallow land affected by finger erosion and patchy stand of cane on eroded slope.

maximum. The average precipitation per rainy day is also highest in the summer months, rising to a maximum of 0·73 inches in January. Unfortunately no detailed information is available regarding the intensity of the rainfall. However, local experience indicates that late spring and early summer storms of three to four inches per hour are not uncommon. Since harvesting is usually completed by the end of December and most of the land is being prepared for January-February planting, the soil is particularly susceptible to erosion at this period.

The soils of the district are for the most part deep, red basaltic loams. There is no sharp line of demarcation between the surface and subsoil, but a gradual transition occurs and the clay content increases with depth. The depth of surface soil varies considerably with the topography, and ranges from four to six inches on non-eroded hillsides, and from ten to fifteen inches on the flat country. The colour is usually dark red-brown or chocolate. The texture is best described as loam. It is underlain by a clay loam or light clay subsoil which is lighter red-brown in colour. This also varies in depth with the topography and may be two to four feet deep on hillsides and eight to twelve feet deep on the lower lying areas.

These soils, under virgin conditions, were highly fertile scrub soils. They were well supplied with humus and in consequence these highly ferruginuous soils possessed a very favourable crumb structure. In addition to their excellent physical condition they were initially well supplied with mineral plant-foods. The attraction of such fertile soils proved irresistible to the early settlers and even the steepest slopes were brought into cultivation. These hillsides have now been under continuous cropping to cane for a period of some 50 to 60 years. During this time much of the organic matter has disappeared and this, together with the constant mechanical effect of cultivating implements, has resulted in a marked depreciation of the original favourable structure. In consequence the soil is now less absorbent of moisture and more readily puddled. The soil immediately below plough depth has become pounded down and much of its permeability has been lost. Such conditions greatly increase erodibility and an accelerated rate of erosion is inevitable under the present methods of cultivation.

The Objective and Design of the Experiment.

The problem, therefore, is to arrest this loss of surface soil in order to prevent further decline in productivity on land which can still be profitably planted. To do this there are several factors to be considered. Firstly, there is the restriction imposed by the assignment system which allows the grower very little opportunity to rest his land under soil-rejuvenating cover-crops in order to restore humus, and thus maintain a satisfactory physical condition. Fortunately, however, the nature of the growth of the cane plant itself is such that it assists in many ways in the prevention of erosion. For instance, because of its ratooning habit it is not necessary for the soil to be brought frequently to a fine tilth, as is the case with crops that are planted annually. Again, the cane rapidly covers in and forms a dense leaf canopy which protects the soil from the full force of torrential downpours. The large number of stalks per stool has a definite filtering effect which impedes and reduces the velocity of run-off water. On the debit side, however, is the fact that, because of the late summer planting of the variety P.O.J. 2878, the soil is usually least protected and most vulnerable during the dangerous period of summer storms.

Furthermore, any system of erosion control must be so designed as not to interfere with cultivation and harvesting methods to such an extent that the cost of production is prohibitively increased. Therefore any terraces, channels, and drainways constructed must be of such a type as to allow unrestricted movement of the fairly heavy mechanical equipment now in general use throughout the district. Consideration must be given to harvesting requirements, particularly as regards the use of portable tramlines.

The Site.

An area of approximately seven acres, located about one mile from Childers, was generously made available for experimental purposes by one of the leading growers of the district. This had been cultivated to cane for approximately 40 years. No rotation to other crops had been practised, with the exception of a few cover-crops grown for two to three months between harvesting and the next planting. The slope is typical of the steeper hillside country, having a maximum gradient of 16 per cent. Some "sheet" and "finger" erosion has affected the area but, given satisfactory weather conditions and adequate fertilization, the land is still capable of producing reasonably satisfactory crops of

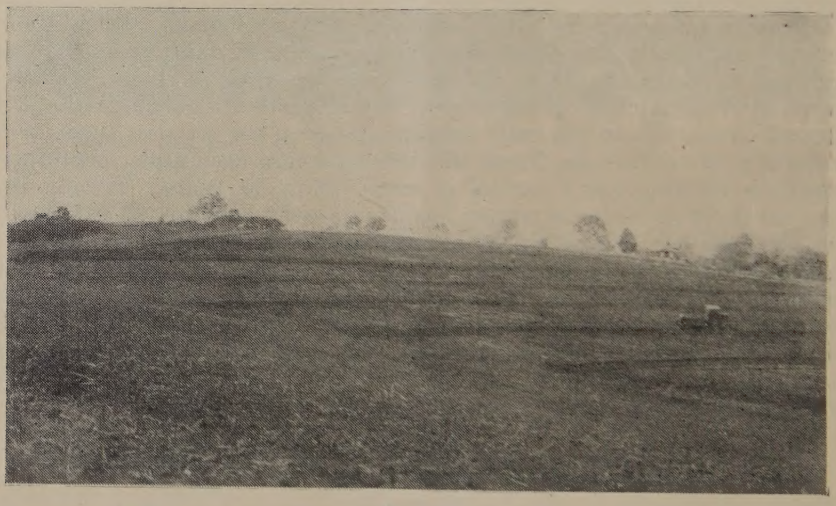


Plate 97.
SHOWING GENERAL LAYOUT OF EXPERIMENT.

cane. The soil is a red basaltic loam and may be regarded as fairly representative. A portion of the area covering approximately four and one-quarter acres is bounded by two natural gullies or waterways. On this a series of broad, shallow ditches following the contour and about 50 feet apart have been constructed. When planted the cane rows will run parallel to these. The remaining two and three-quarter acres is to be used for comparison and will be planted in the manner normally used in the district, i.e., the cane rows will be off level and may have gradients varying from 5 to 10 per cent. Soil samples from the area have been submitted to analysis, as a result of which the land was given a dressing of lime at the rate of one ton per acre and will be fertilized at planting with Sugar Bureau Mixture No. 3 (1·75-10-25) at the rate of 400 lb. per acre.

The Nichols Terrace.

The basic design of the experiment is the series of broad, shallow ditches following the contour (Plate 97). These are flanked on the downhill side by a mound or ridge of earth. The complete unit, i.e., ditch plus mound, is referred to as a "terrace." Eight of these terraces were constructed, all of which lead into a main outlet channel running down the eastern and northern boundaries of the field. The sketch plan given in Plate 89 shows the layout of the terraces in relation to the outlet channel. The function of the terrace is, of course, to divert run-off water into the outlet before it has obtained sufficient velocity to erode the loose surface soil from the cultivated area between terraces. No. 1 terrace occupies the higher portion of the field and there is a vertical drop of approximately 50 feet from No. 1 to No. 8. In order to ensure that the water would move along the terrace channel and so pass into the outlet channel the terraces were given a slight fall as shown in the following table:—

Fall per 100 Feet of Terrace.

0-100	feet of	terrace—	nil grade
100-200	„	„	—1½in. „
200-300	„	„	—2in. „
300-400	„	„	—2½in. „
400-500	„	„	—3in. „

This slight gradient is sufficient to prevent water building up and finally overtopping the terrace but is not great enough to permit rapid movement and consequent scouring in the channel itself.

The type of terrace constructed was primarily of the Nichols type rather than the broad-based Mangum terrace. In explanation of the essential difference between the two types it may be pointed out that the Mangum is fundamentally a broad mound of soil resting on the original soil surface. It is built up by throwing the soil inwards from both sides. There is no definite waterway on the uphill side and the mound itself is depended upon to hold and divert the water along the contour. In the Nichols terrace a broad, shallow channel is cut and all the soil removed therefrom is thrown *downhill* to form the mound. This ensures that the maximum amount of water is carried in the channel. This channel is, of course, below the original soil surface, and should the flanking mound break during heavy rainfall the channel itself still drains away a considerable volume of water. Because of this, the Nichols type of terrace is particularly suitable for areas subject to rainfall of high intensity. The construction of the terraces was carried out with a No. 11 speed patrol road grader. This is a heavy unit of eight tons in weight, with a 60 horsepower Diesel motor and a twelve-foot blade. Some scoop and shovel work was necessary at the ends of terraces, particularly at the junction with the main outlet channel.

The completed terrace is shown in Plate 99. The area of cross-section of the waterway averages approximately three square feet. Whether this is sufficient under the prevailing conditions of run-off and rainfall remains to be seen. Indeed one of the main objectives of this present experiment is to determine the carrying capacity required. It may also be pointed out that, in this work, because of the steep slope, the mound itself is relied upon to provide most of the carrying capacity.

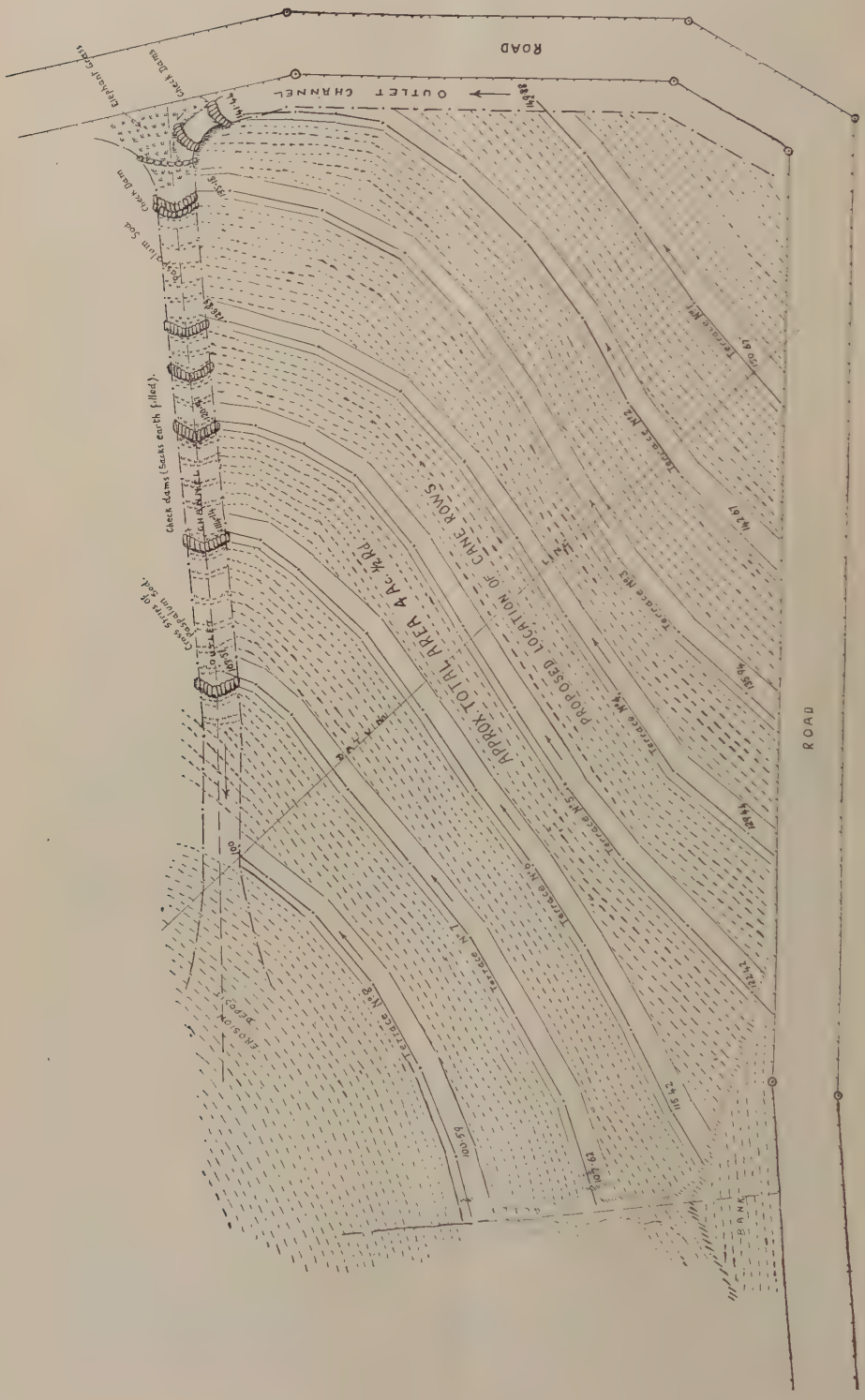


Plate 98.

SKETCH PLAN OF TERRACED AREA.

This is not ideal but is inevitable on slopes of such steep gradient as 16 per cent. On a lesser slope, say five per cent., the carrying capacity of the channel itself would be much greater and practically all the water would be carried in the channel, which is the true function of the Nichols terrace. However, the high degree of slope of this piece of land is probably the maximum with which it will be necessary to deal, and should these experimental terraces prove satisfactory on this field it is felt that they may be constructed with reasonable confidence on the slopes of eight to ten per cent. which are more typical of the district.

The Vertical Interval and Distance between Terraces.

It should be pointed out that because of lack of data on the rate of water movement through these porous red soils the experiment under discussion must be regarded as being purely exploratory. In deciding upon the distance required between terraces there are many factors which must be taken into account. The maximum distance must not

Plate 99.

The Finished Terrace.—The staff is nine feet long and is perfectly horizontal. The greatest depth is ten inches.

be greater than is consistent with safety and the minimum distance must be fixed with due regard to the economic and cultural aspect. The terraces were therefore constructed so as to average not less than approximately 50 feet apart on the steepest portions of the field, i.e., the equivalent of about 11 rows of cane at 4½ feet intervals. As each terrace, i.e., the channel plus mound, occupies approximately 18 feet which will not be planted to cane, it is apparent that the terracing of land at the above intervals results in the loss of three rows in every 11 rows of cane. This loss of over 25 per cent. of production acreage is admittedly important. However, in the interests of safety in the light of overseas work it was considered inadvisable to increase the distance in this particular trial.

In fixing the location of the terraces, therefore, a straight line was taken downhill so as to traverse as far as was possible the steepest part of the slope. Fifty feet intervals were then marked off at which the

terraces would intersect this line. The levels taken at these points gave the vertical interval or drop between adjacent terraces. These, when re-checked after the completion of terracing, gave the vertical intervals as shown in the following table:—

VERTICAL INTERVALS BETWEEN TERRACES.

Between	Terrace	No.	1	and	No.	2	= 8·0	feet.
„	„	„	2	„	„	3	= 6·7	„
„	„	„	3	„	„	4	= 6·5	„
„	„	„	4	„	„	5	= 7·0	„
„	„	„	5	„	„	6	= 7·0	„
„	„	„	6	„	„	7	= 7·8	„
„	„	„	7	„	„	8	= 7·0	„

As minor variations in slope occurred throughout the field there were, of course, variations in the distance between terraces. However, in general they are 55 feet apart with a minimum of approximately 40 feet and maximum of 70 feet. It is expected that systematic

Plate 100.

SHOWING CHECK DAMS FOR STABILISATION OF MAIN OUTLET CHANNEL (UPHILL VIEW).

observations on the behaviour of the terraces with the above horizontal and vertical intervals will provide valuable information from which practical recommendations may be evolved for general application to the district as a whole.

The Main Outlet Channel.

Because of the restricted area available the terraces were of limited length, varying from 200 to 430 feet. It was therefore decided to carry the run-off water along the complete length of the terrace, i.e., from one side of the field to the other. This was done in order to obtain all possible information regarding the behaviour of the water in the

channels. Therefore all the run-off from the field is diverted by means of the terraces into one main outlet channel. As it might reasonably be expected that during heavy rainfall a considerable body of water would be moving down this outlet drain, it was necessary that the drain should be adequately protected. If this were not done, rapid gully erosion might occur in the outlet channel resulting in a considerable increase in depth. Immediately this took place the terrace channels themselves would start to cut back from the point where the water spills over into the deeper outlet. This is fatal in any erosion control system, the field ultimately becoming dissected by a series of uncontrollable canyons. Therefore it must be realised that the formation of the outlet channel is exceedingly important and experience has shown that very often the success of the whole scheme depends upon the satisfactory functioning of the main outlet. The channel constructed was in the form of a broad ditch some 16 feet wide with a shallow V bottom. The gradient of this varied from about 14 per cent. over the first 150 feet to about 10 per cent. at 150 to 300 feet, gradually decreasing till at approximately 900 feet it ran into a wide valley built up with erosion-deposited material. This latter area will be planted with cane which will receive the run-off water in such a greatly dispersed condition that no trouble is envisaged regarding its disposal, particularly in view of the permeable nature of this deep built-up soil.

In soil erosion control work it is now generally recognized practice to form the main outlet channel about twelve months before the channels are constructed. This enables it to be planted with grass or other soil-holding plants in order that it may become well sodded and protected before any water is diverted into it. This precaution, however, was not possible in the present experiment without delaying the scheme for an appreciable period. In view of the exploratory nature of the trial, it was decided to protect this drainway by artificial methods. At the end of each terrace a check dam was constructed across the main outlet by placing fertilizer bags (160 lb. bags) filled with soil in arrow formation pointing down hill (Plates 100 and 101). The location of these in relation to the terraces and also that of some intermediate dams are shown in Plate 98. The bags were let into the soil to prevent movement and undercutting. Paspalum sods were planted beneath the uphill edges. Between each check dam a double row of these sods was also planted right across the outlet, at intervals of six to eight feet. These were watered in to ensure a sucessful strike. A small vulnerable point above the bend of the channel, which received run-off water from a road, was planted with elephant grass and also bolstered with a check dam (Plate 102).

Cultivation of the Area and Maintenance.

It should always be remembered that the construction of terraces alone should not be relied upon completely to control soil-washing in cultivated areas. Contoured cultivation is also necessary, and, in the case of sugar cane, the fact that the planting rows may conveniently be run on the contour is of considerable value in reducing run-off. In this experiment, the cane will be planted parallel to the terraces, the first row in each inter-terrace area being along the downhill margin of the bank of the terrace immediately above. Since the slope is not uniform the width of the strip between any two terraces varies throughout the length, and in consequence, therefore, some short rows are unavoidable on the lower side. In order to avoid damage to the terrace channels

Plate 101.
DOWNHILL VIEW OF CHECK DAMS IN MAIN OUTLET CHANNEL.

and mounds, it has been decided that cane will not be planted within nine feet of the centre of any channel. As previously pointed out, this will result in the loss of about three rows of cane in eleven. This is undesirable, but necessary in order to determine the stability and required carrying capacity of this type of terrace. Actually, because of the broad, shallow nature of channel and mound, it would be possible to plant cane, as far as soil suitability is concerned, to within about 4½ feet of the centre of the channel. This would mean that only one row of cane would be eliminated. Sufficient information may be available at the time of ratooning to warrant an experimental planting of the two additional rows.

Plate 102.
PROTECTION, BY MEANS OF ELEPHANT GRASS AND CHECK DAM, OF VULNERABLE POINT WHERE MAIN OUTLET CHANNEL CHANGES DIRECTION.

Because of the exploratory nature of the trial, no information is yet available on the amount of maintenance that will be required on terraces set out in this particular type of soil. Since it will presumably be necessary to control weed-growth on channels and mounds, the use of some type of scraper weeder is envisaged. It is considered possible that a blade mounted on a scarifier frame may be adapted to destroy weeds and at the same time carry out any reshaping that may be necessary.

TRENCH SILAGE.

The making of trench silage is a satisfactory method of conserving fodder for drought reserves when it is to be kept for periods of a year or more. Next to stacking, ensiling in trenches requires the least capital outlay. Once built in a suitable situation, trenches are long lasting, and although not quite as satisfactory as tower silos, their use is an excellent way of becoming familiar with the making and feeding of silage.

For preference a high spot, where there is no danger of seepage or of underground water lying, should be selected. Such a site can be found on nearly every farm. Avoid the heads of gullies and other depressions. The top of a ridge or spur is a particularly good site, especially if drainage can be obtained from the pit at one end. Good drainage (so that water will not run into the pit) is the main consideration. If this is available pits may be successfully constructed on flat country, but the site should not be subject to flooding.

In inland districts any red soil will be suitable. In general, clay soils are to be avoided as they tend to crack and allow the entrance of air at the sides of the silo.

When sheep are to be fed from the pit, it is an advantage to have it as close as practicable to the crop, to reduce the expense of cutting and carrying; but on the dairy farm a position in proximity to the bails has more to commend it, as ease of feeding is an important consideration.

Size of Trench.

The present tendency is towards the making of small pits of 35 to 40 tons capacity. Extra capacity is obtained preferably by lengthening the pit rather than making it wider or deeper. This facilitates filling and covering, and there is less shrinkage. In addition, cutting on the small face exposed in a long pit leaves less material exposed to the air. This is an advantage if a trench is opened, but not completely emptied, at any time.

A pit to hold 35 tons should be 50 feet long at the top, 20 feet long at the bottom, and 5 to 6 feet deep. It should taper from 9 feet wide at the top to 8 feet wide at the bottom. A trench 80 fet long by 14 feet wide, 4 feet deep, holds 70 tons. It is geenrally better, however, to have two small trenches rather than one big one, as filling and feeding out are facilitated.

The walls should be smoothly finished with a slight batter, to allow free settling and ensure a constant downward pressure of the silage on the walls. By this means there is efficient exclusion of air, and mould growth along the walls is prevented.

An effective type of pit can be made on the side of a slope with a gradient of about 1 in 10, the end of the trench on the up-side of the slope being given a batter of 1 in 3. The other end is allowed to run out to ground level on the down-side of the slope, this permitting of effective drainage and ease of filling.

The smallest satisfactory size of pit is about 20 tons capacity, while the largest should not exceed 70 tons. In excavating, it is safe to estimate the silage capacity of a pit, as at the rate of 1 ton of silage for each 2 cubic yards excavated below ground level. A good crop of wheat or oats will cut between 4 and 5 tons of silage to the acre, while on the coast Japanese millet will cut about 8 to 10 tons, and maize between 12 and 25 tons to the acre. Usually the yield of silage from a maize crop would lie between 15 and 20 tons, and the yield from Saccaline sorghum is generally a little lighter.

PLANT PROTECTION

Black Rot ("Rust") on Cabbages and Cauliflowers.

J. E. C. ABERDEEN, Pathologist, Science Branch.

BLACK rot has caused very severe losses in early cauliflowers this year. Many growers are not aware of the cause of this disease or the control measures that may be taken to reduce losses, and so the following notes are published for their information and future use.

The disease may occur on either cabbages or cauliflowers. The name black rot by which it is known throughout the world is in some ways misleading to the grower, because the most obvious symptom is the occurrence of yellow-brown areas around the edges of the older leaves. These leaves later fall off, but similar diseased areas will appear progressively on the younger leaves as the disease advances. This appearance has lead to the disease being known as "rust" to some farmers. On further development, if the diseased leaf is broken dark strands will be seen in the main vein of the leaf, and later still, similar black stands appear in the main stem. A striking fact about this disease is the rapidity of spread after a spell of rainy weather. So striking is this that the rain is often regarded as being the cause of the disease.

The true facts in the development of this disease are that it is caused by particular bacteria whose growth and multiplication is favoured by very warm weather. In addition, to enable it to spread, it must have abundant moisture, preferably wind-blown showers. The period of the year when these conditions are best fulfilled is from late January to the end of March, so the main epidemics are amongst the "early" cauliflowers and cabbages.

The more obvious symptoms as described above do not become common until the wind and rain commence transferring the bacteria from one plant to another. The disease first enters the crop either through the seed or from the soil. In the case of the soil, the carryover is considered to be principally in the cabbage and cauliflower trash that is rotting in the soil, and possibly in the soil itself.

In considering the aspect of infection from the soil, attention should be focussed on the seed-bed, as conditions favourable for spread of the disease are more likely to occur there than in the field and there is a very large concentration of plants in a small area. It is estimated that it takes two to three weeks from the time of infection before any definite symptoms appear on an infected leaf. Consequently the disease would rarely be seen in the seed-bed even if the spread had been active in that period of the plant's growth.

Control.

Spraying of the crop in the field is unsatisfactory, so control measures are confined to (1) treating the seed, (2) ensuring a disease-free seed-bed. The evidence this year strongly suggests an original seed infection, so seed treatment is particularly emphasised.

The most successful treatment is to immerse the seed in water at a temperature of 122 deg. F. for thirty minutes. Disinfection with corrosive sublimate using a strength of 1–1,000 for thirty minutes may also be used, but this method is not considered quite so effective as the hot-water treatment.

In selecting areas for seed-beds most growers take such precautions as using land where cabbages or cauliflowers have not grown before, but it seems that more definite steps must be taken and the seed-bed actually treated by either fire or formalin, and then reasonable precautions taken not to introduce untreated soil into the beds on rakes and other implements. Details of these methods of treatment are readily obtainable from the Department if required.

FODDER CONSERVATION.

Some useful and interesting information on the amount of labour involved and the cost of constructing and filling a trench silo on his property has been supplied by Mr. A. Cockerill of Mulgeldie.

Mr. Cockerill writes that he had the trench made by contract with modern earth-moving equipment at a cost of £22 10s. The dimensions at the top are 110 feet long by 12 feet wide, and at the bottom 38 feet long by 10 feet wide. The depth is 8 feet. A calculation shows that the capacity of this trench at ground level is 120½ tons; but Mr. Cockerill has filled it higher than this and has consolidated the ensilage with a tractor, so that he should have an actual tonnage greater than this.

To fill the trench, Mr. Cockerill grew 10 acres of saccaline. The land had two ploughings and harrowings, and the seed was sown with a combine at 10 lb. to the acre. The corp was cut with a tractor-mower when 10 feet high. It took 280 man-hours to fill the trench, 15 hours to place 15 loads of grass over the saccaline, and another 40 hours to scoop a good layer of soil over the whole lot. The crop was carted to the trench with a ton truck. The total mileage was 162 miles.

Costs are set out by Mr. Cockerill as follows:—

	£	s.	d.
Construction of trench	22	10	0
Ploughing and harrowing twice at £1 per acre each time	20	0	0
Seed and sowing	4	1	6
Cartage, 162 miles at 8d per mile	5	8	0
Labour, 350 hours at 2s. per hour	35	10	0
Mowing, 10s. per acre	5	0	0
	£91	19	6

He has therefore laid down at least 120 tons of ensilage at a reliably estimated cost of about 15s. per ton. Mr. Cockerill estimates the value of the silage at £2 per ton, but his neighbours variously value it at £4 to £8 a ton. The point of interest, however, apart from the value, is that he has insured himself against loss of his herd in any future dry season.

Fertility and Infertility of Sheep.

G. R. MOULE, Officer-in-Charge, Sheep and Wool Branch.

INTRODUCTION.

STRICTLY speaking, fertility refers to the capacity of any species of animal to reproduce. Infertility infers that the animals are incapable of producing offspring. In the sheep areas of pastoral Queensland, however, the use of these words has been corrupted and the level of the fertility in a flock is often gauged by the percentage of lambs marked to ewes mated. This is really a crude measure of the flock's reproductive rate in a particular year.

In this article, many factors influencing the reproductive rate of sheep, besides fertility and infertility of ewes and rams, are discussed. The importance of a high reproductive rate in flocks cannot be over-emphasised. The average useful life of a sheep is not long, and accordingly every breeding flock must replace itself completely in about five years. Droughts have taken heavy tolls of the sheep population in Queensland. On more than one occasion, woolgrowers have been called upon to rebuild their flocks. Under these circumstances a high rate of reproduction is essential.

The gross rate of reproduction in a flock is governed by (1) the number of seasons during which the ewes are mated; (2) the yearly death rate of breeding ewes; and (3) the percentage of ewe lambs marked to ewes mated.

A more correct measure of the reproductive rate considers the replacement of breeding ewes; that is, cognizance must be taken of the proportion of losses amongst ewe lambs before they reach sexual maturity. This is sometimes referred to as the net reproductive rate, and it influences the rapidity with which flocks can be rebuilt after severe drought losses, the age at which ewes may be cast and the degree of selection which might be practised amongst young ewes.

Recognised methods of good sheep husbandry necessitate the regular and systematic "culling" of the young sheep in order that any animals which do not conform to reasonable standards of breed type, or which are likely to be indifferent wool producers, might be removed from the flock. Because of a low reproductive rate amongst their flocks many wool-growers, particularly those in north-western Queensland, are unable, in a large number of years, to cull their sheep. This in itself may hinder an improvement in the efficiency with which wool is produced.

THE FERTILITY OF EWES.

The Process of Reproduction.

The main organs of reproduction in any female animal are the uterus (the womb or breeding bag) and the ovaries. In ewes the ovaries are small bodies each about the size of a large green pea. The uterus is a small muscular bag capable of great expansion and is shaped somewhat like a pair of riding trousers. It has a body and two fairly long horns. From these, fine tubes, known as the Fallopian tubes, lead towards the ovaries on their respective sides. The Fallopian tubes are not connected to the ovaries but terminate in a small funnel just near them. The body of the uterus is contracted into a narrow neck, known as the cervix, just where it joins on to the upper end of the vagina, which is commonly known as the "breeding passage."

The ovaries are important because they form a minute egg, known as the ovum. This has the capacity, under certain circumstances, of developing in the uterus into a new individual. The ovary is also responsible for the elaboration of hormones, which circulate in the blood. These play an important part in the maintenance of pregnancy and in the development of the characters associated generally with femininity of ewes.

Changes take place in the ovary and these are bound up with the formation and liberation of the ovum. When liberation occurs, the shed ovum finds its way slowly down the Fallopian tube into the uterus, which it reaches in about 70 hours. At about this time the ewe experiences a period of sexual desire known as oestrus or heat and she will permit service. In most cases oestrus lasts for about 24 hours, though there is some variation. The ovum is shed towards the end of oestrus. During service the ram deposits semen in the upper end of the vagina and near the cervix.

The semen consists of a very large number of minute organisms, known as sperm, suspended in a special fluid secreted by some of the glands associated with the reproductive organs. The sperm swim through the narrow opening in the neck of the uterus and continue on until they reach the tip of the horns within about five hours after being deposited in the breeding passage. They then ascend the Fallopian tubes. The first sperm to meet with the ovum fuses with it, and at this stage fertilization is said to have taken place. It is from the fertilized ovum that the new lamb develops. If two ova are shed at one time and both are fertilized the ewe has twins. Fertilization usually takes place when the ovum is about two-thirds of the way down the Fallopian tube. After fertilization the ovum develops a thickened coat about itself and in most cases this prevents other sperm from entering. The fertilized ovum moves down the remaining portion of the Fallopian tube and enters the uterus. Fertilization is followed by a period of rapid cell division and before long the ovum attaches itself to the lining of the uterus. As development takes place a set of membranes, known to most stockmen as the "water-bag," is formed. The membranes perform a number of functions, which include establishing close contact with the lining of the uterus, thereby ensuring that the embryo is well fed. They also secrete a hormone which has an important bearing on pregnancy and affords a certain amount of protection to the developing young.

It is usually stated that the gestation period for ewes (that is, the time from fertilization of the ovum until birth of the lamb) is five months. Actually it varies from about 142 days to 152 days.

During the last two months of gestation the lamb develops rapidly. At this time the nutritive requirements of the ewes increase proportionately. In the event of the ewes being on poor pastures, they draw on the stores of calcium, protein, and vitamin A which are laid down in their body tissues. In times of stress the requirements of the lamb take preference over those of the mother. Changes take place in the

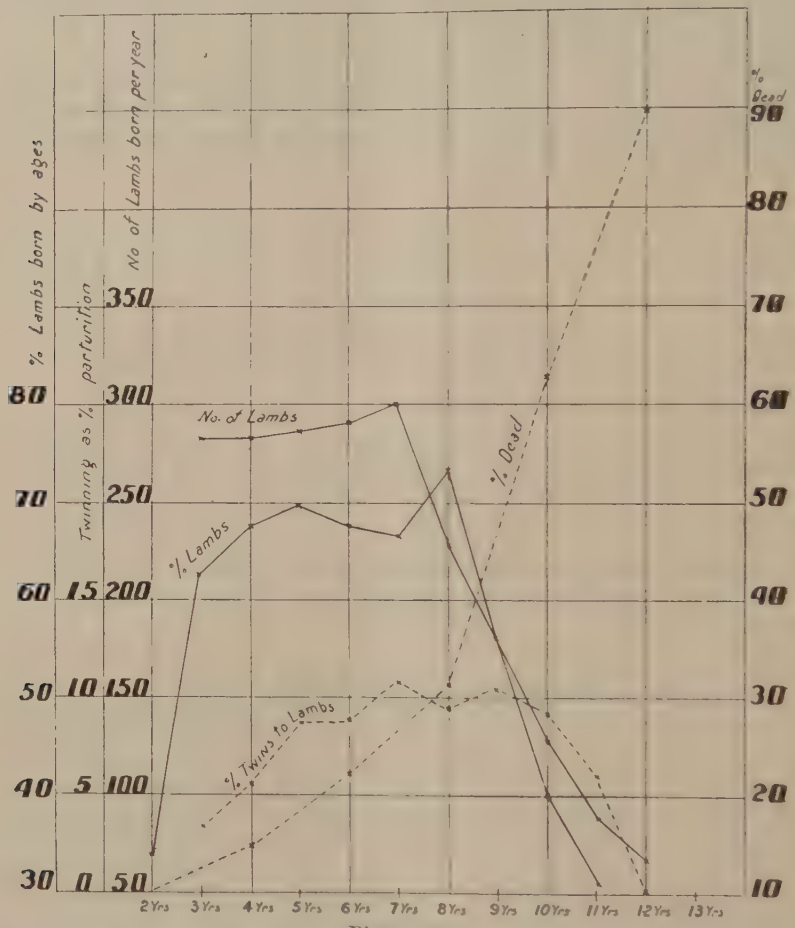


Plate 103.

SHOWING THE RELATIONSHIP BETWEEN FERTILITY, TWINNING, MORTALITY AND AGE.
[Graph by Dr. R. B. Kelley.

mammary glands or udder, which commences to produce milk. Finally, when gestation is complete the contact between the membranes and the lining of the uterus breaks down. The uterus contracts and, aided by the powerful seizures of the abdominal muscles, the lamb is born.

In the event of fertilization not taking place and/or normal pregnancy not occurring, the ovum does not attach itself to the lining of the uterus and it is finally voided. Under these circumstances, further changes take place in the ovaries and a new ovum is subsequently shed within from about 16 to 19 days. These cyclical changes are referred to as the oestrus cycle and their occurrence has an important bearing on fertility of sheep and on flock management.

Female Aspects of Fertility.

A large number of factors influence the reproductive capacity of ewes. These include breed, age, and environmental conditions. Permanent infertility due to disease is not generally common amongst ewes.

It is well known that English sheep are much more fecund than Merinos. Twinning is more common in Romney Marsh and Border Leicesters than in Merinos, and in addition ewes of the English breeds are reported to have a longer breeding life, and being bigger they probably do not suffer so much trouble at lambing time.

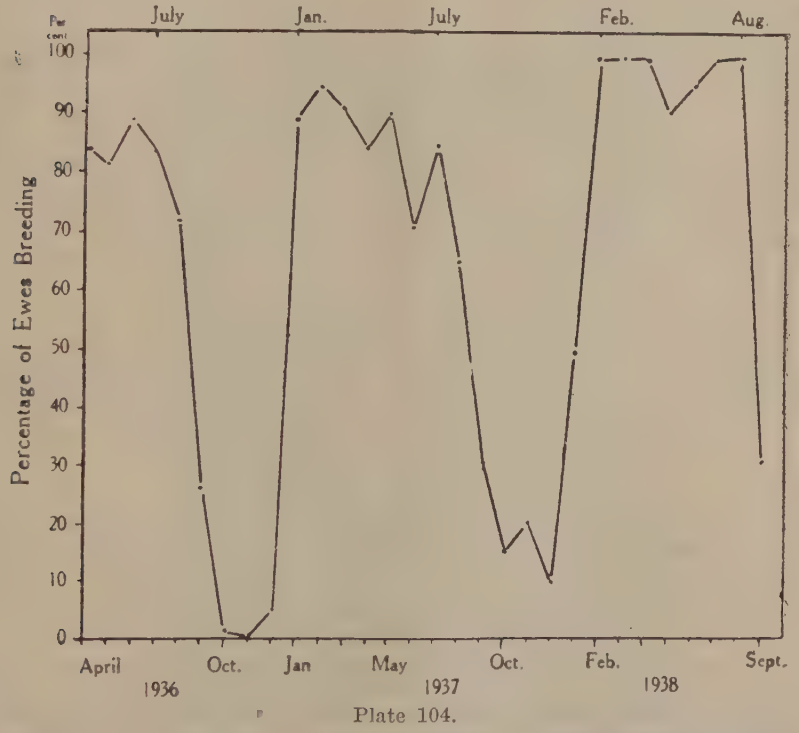


Plate 104.

SHOWING THE EFFECT OF SEASON ON NUMBER OF EWES COMING ON HEAT.

[*Graph by Dr. R. B. Kelley.*

Age is important, because as the ewes reach maturity the incidence of twinning increases. After full maturity is reached, however, the percentage of deaths attributable to lambing increases rather rapidly. These facts are depicted graphically in Plate 103.

It has been clearly established that in Australia ewes running continuously with rams exhibit a definite breeding season. This commences in midsummer, continues on through the autumn and winter, and ceases during the spring or early summer. During this time a maximum number of ewes in the flock come on heat every 16 to 19 days unless they are served by fertile rams and become pregnant. This is expressed graphically in Plate 104.

Work undertaken at Cambridge indicates that these periodic variations in the incidence of heat in ewes is controlled by the amount of daylight to which the sheep are subjected. However, there is a lag between the changes in the length of day and the frequency of heat. This would bring about a decrease in the incidence of oestrus in a flock in the late winter, spring, and or early summer following the shorter days of winter.

There is field evidence to suggest that there are other factors which may influence the occurrence of heat amongst a flock. Stud records reveal that the majority of ewes conceive about three weeks after the rams are joined. This suggests that the presence of rams amongst ewes which have not been mated for a considerable time may have some effect in stimulating oestrus. At the same time it is known that ewes mated in October-November have given birth to a large number of lambs and this may be attributable to the same cause. In a trial conducted in Northern Queensland it was found that 76 per cent. of the ewes came on heat within 24 days when mated in November. These facts indicate that oestrus or heat may occur in ewes mated out of what might be regarded as the normal season. However, the incidence of oestrus may not be as high at that time of the year as it is between January and August.

THE FERTILITY OF RAMS.

As it is usual to mate only about 2½ per cent. or 3½ per cent. of rams with the ewes, infertility on their part is of major importance. An infertile ram may mean that from 30 to 40 ewes do not conceive and this is reflected readily in the reproductive rate of the flock.

The Male Reproductive Organs.

The main organs of reproduction are the testicles (of which there are two), the epididimi, one being attached to each testicle, the vas, the seminal vesicle, and the penis. In addition there are some important glands which secrete some accessory fluids.

The microscopic structure of the testicle is particularly interesting. It is composed of a large number of very fine tubules each of which is lined with a layer of tiny brick-like cells. These have the capacity to divide and of undergoing special changes which result in the formation of minute organisms which have a head and a tail and are shaped somewhat like a tadpole. They are known as sperm. The tail of the sperm is very long and mobile. Its lashing movement provides a means of propulsion whereby the sperm swims and, considering its size, the progress it makes is remarkable. Within the tubules of the testicles the sperm are packed together somewhat like a large number of saucers stacked one on top of the other. They move slowly through the tubules till they reach the epididymis. This acts more or less as a marshalling yard where the sperm are collected. They then pass up the fine thick-walled tubes known as the vas. The vasa from each testicle meet at a small vesicle, known as the seminal vesicle, which is used as a store-house for the sperm. The seminal vesicle is located just near the neck of the urinary bladder and it opens into the base of the penis. Close to the vesicle are the accessory glands. Their function is to provide a medium in which the sperm can swim.

During service the seminal vesicle contracts quickly and the semen is ejected forcibly through the penis. It is deposited in the upper part of the breeding passage of the female and the sperm then begin their journey in search of the ovum.

The testicle is adequately supplied with blood and the veins which carry the blood back to the body are well developed. They are contained within a thick cord which can be felt in the neck of the scrotum or purse and are surrounded by a fairly strong sheath of muscle. This muscle has the power to draw the testicle up close to the body. Both the testicles and the epididimi elaborate male sex hormones which circulate in the blood and govern the development of masculinity of rams.

Plate 105.
Normal, Highly Fertile Ram Semen.

The Characters of Normal Fertile Semen.

It is often suggested that as only one sperm is required to fertilize an ovum it does not matter very much if there are a large number of abnormal sperm in a semen sample. This is not the case. Many characters appears to affect the fertilizing capacity of the semen.

Good quality semen (Plate 105) contains an adequate number of normally shaped sperm which are actively motile and are capable of living a long time. In addition, chemical changes indicative of the normal functions of life take place in a sample of semen which has a high fertilizing capacity.

Nature is notoriously wasteful in all matters pertaining to reproduction and accordingly it is common to find 30,000,000 normal active sperm in one cubic centimetre of good quality semen.

As each sperm is capable of fertilizing an ovum, normal semen samples can be diluted into special fluids and used to inseminate artificially a large number of ewes. Probably this has led to some advancing the argument that it does not matter if the semen is deficient in a few hundred thousand or perhaps a million sperm per c.c., or if a few sperm have not got all the characteristics of a good quality sample.

Plate 106.

SEMEN FROM A RAM SUFFERING FROM SEMINAL DEGENERATION.—Note the abnormal tails and the heads broken from the tails.

It is important to remember, however, that even a slight deficiency in any one character of the semen, whether in numbers, motility, longevity, shape, or essential chemical changes, should be regarded as an abnormality, which is likely to render the ram wholly or comparatively infertile.

When the semen fails to show all the characteristics which are considered to indicate it is normal, it is said to have degenerated (Plate 106). Seminal degeneration may be slight or advanced, temporary or permanent. A ram suffering from seminal degeneration which is advanced and permanent is likely to be completely sterile. An animal suffering from seminal degeneration which is slight and temporary may not get many lambs during one joining. He will recover, however, if given appropriate attention and correct management, and during the next joining may secure a large number of lambs.

The following tables indicate the effect which different types of seminal degeneration have on the fertility of rams:—

Percentage Abnormal Sperm.	Percentage Likely Fertility.
0.1	90—100
1.0	60
10.0	45
30.0	30
More than 50.0	0

It is important to understand and to be able to recognise the factors which are likely to bring about seminal degeneration in rams, thereby rendering them infertile.

Factors Influencing the Fertility of Rams.

A large number of factors may adversely influence the quality of the semen produced by rams and the results they produce may be temporary or permanent. Accordingly these are dealt with separately.

(a) Temporary Infertility.

It is known that rams enjoying normal sexual health may produce semen which varies in quality depending on the weather conditions and the diet as well as on the occurrence of arsenic in wool. The details are as follows:—

(i.) *The influence of diet.*—Adequate vitamin A is necessary to maintain the cells lining the tubules in the testicle in good health. These cells are very important because they actually make the sperm. If the ration is deficient in vitamin A the cells degenerate and abnormally shaped sperm without tails are produced. Consequently the fertility of the ram falls.

Russian workers estimate that a ram which is producing as little as 5 c.c. of semen per week requires 13 oz. of digestible crude protein per week for semen production alone.

Both protein and vitamin A are found mainly in green grass but dry grass is notoriously deficient in these requirements. It is doubtful if rams confined to a diet of dry Mitchell grass would get as much as 13 oz. of digestible crude protein per week. They certainly would not get sufficient vitamin A. A certain amount of vitamin A is stored in the sheep's liver during times of plenty, but this is slowly exhausted when the animal is placed on a vitamin A-deficient diet.

At the same time the replenishment of the vitamin A stores of the liver are slow when an adequate ration is provided. These are important points to remember when rams are being prepared for joining. In the north-west and the northern part of the central-west, where the winters are usually dry, the rams are subjected to a prolonged period of vitamin A and protein deficiency, and in consequence the quality of the semen produced by them during the summer is low. It may take from six to eight weeks for the rams to recover and to produce normal semen after being provided with an adequate vitamin A intake, as occurs after the summer rains fall.

(ii.) *The influence of high temperatures.*—It has been clearly demonstrated that high body temperatures of rams may cause considerable seminal degeneration and render the animal comparatively infertile. Several factors can bring about a high body temperature, including

fly strike, or any other fevered condition, exercise, and high atmospheric temperatures. When atmospheric temperatures rise above 72 deg. F the muscles ensheathing the veins of the testicle relax and these glands become more dependent and hang lower than during cool weather.

The exercise associated with long walks for water and/or feed, chasing maiden ewes, or being driven long distances on warm days can easily increase the temperature of rams and thereby bring about a certain amount of seminal degeneration.

Warm weather usually associated with summer conditions will also render rams temporarily infertile. Atmospheric temperatures as high as 95 deg. F with occasional rises to 100 deg. F will have such an adverse effect on rams that they will probably get very few lambs if mated at that time.

No very noticeable symptoms are seen in sheep suffering from seminal degeneration due to hot weather. The testicles may be soft and flabby and lack the resilience associated with the glands of animals producing normal sperm.

(iii.) *The effect of arsenic on the fertility of rams.*—Rams appear to be very susceptible to conditions which are likely to produce seminal degeneration and it is probable that all of these are not, as yet, understood. However it is known that dipping rams carrying half fleece in an arsenic solution or jetting them with arsenic at such a time will have an adverse effect on the quality of the semen produced for as long as about 40 days. Arsenic, however, does not appear to have any very lasting deleterious effect if the rams are carrying less than six weeks wool.

(b) Permanent Infertility.

Several conditions, which are really diseases specific to the male reproductive organs, may render rams permanently infertile. A survey of rams in Queensland indicates that these diseases are fairly common and accordingly a large number of animals which are joined each year are comparatively useless. The specific diseases which cause infertility of rams are:—

(i.) *Orchitis.*—Orchitis is the name given to those conditions in which there is inflammation of the testicle or testicles. It may be caused by a large number of factors, which vary from mechanical injury as occurs in dingo bites to abscesses caused by bacteria. It is usually found that rams suffering from orchitis have one testicle larger than the other and the affected gland may be hot and sore or hard and scarred. In this latter case it may be adherent to the skin of the scrotum and cannot be moved within the "purse" with the ease usually associated with normal healthy testicles.

The effect of orchitis on the general health of the rams varies with the nature and cause of the complaint. If the condition is acute and has resulted from an invasion of the testicle with pus-forming bacteria, the gland becomes hot and sore, the ram may be disinclined to walk and it shows the typical reactions associated with fever. On the other hand, if the inflammation of the testicle has resulted from mechanical injury or from a mild infection by bacteria which runs a slow chronic course, the general health of the ram may not be noticeably affected.

The treatment of rams suffering from orchitis is difficult and it is doubtful if full fertility can ever be restored.

Plate 107.

EPIDIDYMITIS OF RAMS.—Note the normal testicle on the right hand side of the picture and the abnormal one on the left hand side.

[*Photo.: Australian Wool Board.*

Plate 108.

EPIDIDYMITIS OF RAMS.—Note the rounded end on the affected testicle on the left hand side of the picture. The gland on the right is normal.

[*Photo.: Australian Wool Board.*

(ii.) *Epididymitis.*—Epididymitis is the name given to conditions producing inflammation of the epididymis (Plates 107 and 108). This disease is particularly common in Queensland and, as it does not affect the general health of the rams, it often escapes notice.

Careful examination of the testicles will reveal that there is a small peglike structure on the lower end of each gland. This is the tail of the epididymis and its head can sometimes be felt as a slight elevation on the back of the upper end of the testicle. When the epididymis becomes inflamed the head or tail may become enlarged and hardened and under these circumstances can be felt quite easily. Epididymitis is much more common in older sheep than in young ones. In a recent survey it was found that 87 per cent. of the rams over six years of age in a certain flock were affected with this condition. These animals were almost entirely infertile.

The usual history of a ram affected with epididymitis is as follows. The animal becomes less fertile, although there is no gross abnormality of his reproductive organs. Later enlargement of some part of one epididymis is apparent and the animal becomes comparatively infertile. If only one side is affected the ram may become fertile again within about four or five years of first becoming affected. It is hardly worth keeping flock rams in the hope that they will recover.

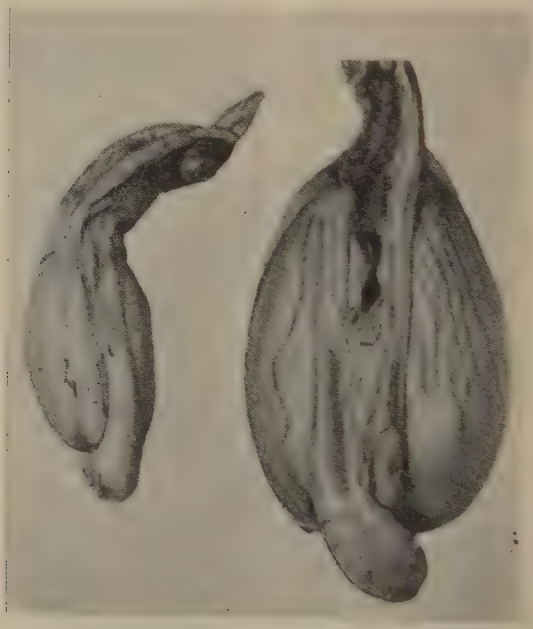


Plate 109.

TESTICLES AFFECTED WITH HYPOPLASIA (LEFT) AND HYPERPLASIA (RIGHT).

(iii.) *Hypoplasia, and hyperplasia of the testicle* (Plate 109).—Hypoplasia means shrinking or shrivelling, while hyperplasia means gross enlargement of a part, organ, or gland. It is not uncommon to find that one testicle is suffering from hypoplasia while the other is showing distinct hyperplasia. Hypoplasia and/or hyperplasia may result secondarily from orchitis, but this is not necessarily the case. In all events it is as well to reject rams suffering from these conditions as they are usually infertile.

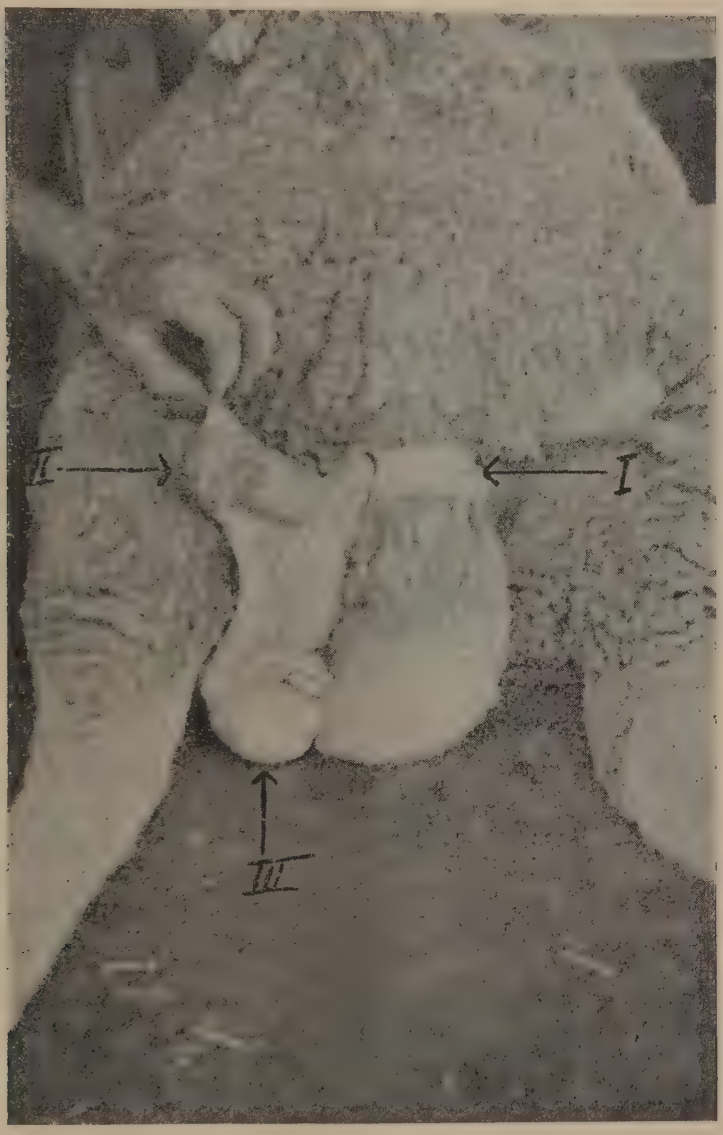


Plate 110.

VARICOCELE OF RAMS.—Note enlarged neck of scrotum (I.), the varicosed veins (II.), and the testicle (III.).

(iv.) *Varicocele.*—Occasionally the veins which return the blood from the testicles become varicosed. This is referred to as varicocele (Plate 110). This condition seems to be fairly common amongst rams in Queensland and it can be an important source of lowered lambings. If the condition is advanced it may get quite painful and the sheep become incapable of walking long distances. Rams which are affected to this extent assume a typical humped-up attitude with their back legs drawn up under them (Plate 111).

Plate 111.
TYPICAL STANCE OF A RAM SUFFERING FROM VARICOCELE.

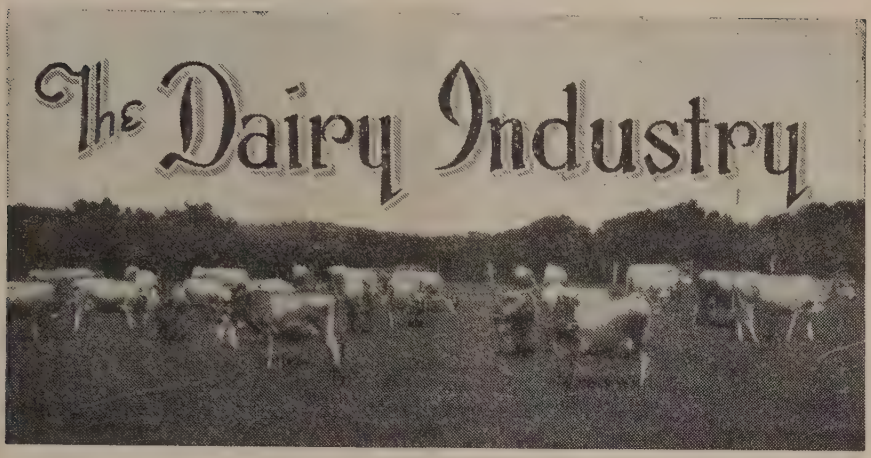
Examination of the neck of the scrotum will reveal a thickening of the veins of the main cord leading down to the testicles. The extent of the thickeneing varies but an important feature is that it is not possible to reduce the swelling.

Varicocele may not produce marked seminal degeneration, but affected rams are often handicapped through not being able to travel very far.

(v.) *Rupture.*—Rupture or hernia is a condition in which a loop of bowel slips through the small slit-like opening in the abdominal wall through which the vas and blood vessels of the testicle pass into the neck of the scrotum. When this occurs the affected animal might become quite infertile.

The presence of the loop of bowel in the neck of the scrotum produces a thickening which resembles that seen in varicocele, except that the swelling can be reduced by returning the bowel into the abdominal cavity.

[TO BE CONTINUED.]



Butter Factory Over-run.

V. J. BRIMBLECOMBE, Senior Adviser in Dairying, and F. TREACY, Inspector of Accounts, Dairy Produce Acts.

OVER-RUN is defined as the amount by which the quantity of butter actually manufactured by a factory exceeds the quantity estimated on the butter-fat content of the cream received.

When the supplier's cream is received at the factory it is weighed and tested for butter-fat content and the quantity of commercial butter which can be manufactured from it is calculated by means of a chart designed for the purpose. The figure thus obtained is used as the basis of payment for the cream. Weighing and testing indicate the amount of butter-fat actually contained in the cream, but since, in addition to butter fat, butter also contains water, salt, and a small quantity of milk curd, the actual quantity of commercial butter which can be manufactured from a given quantity of cream is considerably more than the amount of butter-fat it contains. The chart is simply a table showing the quantity of butter which can be made when the butter contains an average amount of water, salt, and curd and it obviates the necessity for making involved calculations. Extracts from these "Butter Computing Tables" as they are called are given below for purposes of illustration—

40 Per Cent. Cream Test.		42 Per Cent. Cream Test.		43 Per Cent. Cream Test.	
Cream. Lb.	Commercial Butter. Lb.	Cream. Lb.	Commercial Butter. Lb.	Cream. Lb.	Commercial Butter. Lb.
40	19·560	40	20·5680	40	21·0720
45	22·005	45	23·1390	45	23·7060
50	24·450	50	25·7100	50	26·3400
100	48·900	100	51·4200	100	52·6800

(In actual practice, factories ignore the decimal points and calculate to the nearest pound.)

The chart quoted is the one in general use in Queensland and it is based on the assumption that the butter manufactured will contain 14 per cent. of water. However, the maximum amount of water which butter may contain under the Dairy Produce Acts is 16 per cent. and buttermakers frequently produce butters having a water content of 15·5 per cent. and higher. It will therefore be readily understood that the quantity of butter actually manufactured usually exceeds the quantity estimated from the chart. This excess is the basis of the over-run.

To ensure that suppliers receive payment for all butter made from the cream supplied by them, the law provides that this over-run be distributed to them in proportion to the quantity of commercial butter which the chart indicates can be made from the cream supplied by them. If, for example, by reference to the chart, a factory estimates from the weight and tests of the cream received that its manufacture for a particular month will be 100,000 pounds and it actually manufactures 102,500 pounds, it is said to have an over-run of 2,500 pounds. This represents 2½ per cent. of its estimated manufacture and in order to distribute this amount to its suppliers each supplier should be credited with an additional 2½ per cent. of the commercial butter already credited to him as calculated from the chart. The following is a typical advice docket showing how the over-run is credited:—

ADVICE DOCKET.

SUNNYMOUNT CO-OPERATIVE ASSOCIATION LTD.

Advice docket showing cream received, butter estimated, and over-run for the month ended 31st May, 1947, on account of John Smith, Alma-den.

Date.	Nett Weight of Cream Received in Grades. Lb.			Test. Per Cent.	Butter Estimated in Grades. Lb.		
	Choice.	First.	Second.		Choice.	First.	Second.
2 ..	64	..	..	36	28	..	..
6 ..	69	..	..	36	30	..	..
9 ..	60	..	..	37	27	..	..
13 ..	..	67	..	36	..	29	..
16 ..	62	..	..	36	27	..	..
20 ..	..	..	61	38	..	..	28
23 ..	..	60	..	37	..	27	..
27 ..	63	..	..	37	28	..	..
30 ..	58	..	..	37	26	..	..
Totals ..	376	127	61	..	166	56	28

Deductions:

	£	s.	d.
Cartage ..	0	10	0
Goods ..	1	5	6

		£	s.	d.
Choice	166 lb. at 1s. 8½d.	14	3	7
Over-run, 2½ per cent.	4 lb. at 1s. 8½d.	0	6	10
First	56 lb. at 1s. 8d.	4	13	4
Over-run, 2½ per cent.	1 lb. at 1s. 8d.	0	1	8
Second	28 lb. at 1s. 7d.	2	4	4
Over-run, 2½ per cent.	1 lb. at 1s. 7d.	0	1	7
Total Gross Pay		£21	11	4
Total Deductions		1	15	6
Nett Pay (Cheque herewith)		£19	15	10

Factors Affecting Over-run.

While the foregoing indicates the basis of over-run, there are other factors which affect it, the most important of which are as follows:—

1. Faulty factory scales and irregularities in weight.
2. Inefficient testing and faulty glassware.
3. Slovenly factory practices.
4. Faulty butter composition, low moisture and salt, and loss of salt.
5. Faulty factory equipment.

1. **Weight.**—The correctness of all scales at a butter factory is an important factor in controlling the over-run. Factory scales are periodically inspected by the Weights and Measures Department to test their accuracy, but it should be a routine duty in all factories, before commencing operations each day, to check and adjust them with a standard weight. Weights of cream are very important, and if incorrect due to faulty or unbalanced scales the over-run will be affected. If the weights as recorded are higher than the actual quantity received the estimate of butter manufactured is increased and the difference between it and the butter actually manufactured, that is, the over-run, is decreased. Conversely, if the weights are recorded at a figure lower than the correct amount the estimate of manufacture is lowered and the over-run increased correspondingly. Faulty tare weights on cans will cause errors in cream weight and consequent variations in over-run.

It is the usual practice to weigh cream to the nearest pound. In ordinary circumstances this give and take system works sufficiently accurately and equitably for factory practice.

Care is required in weighing the butter into the boxes for export and local sales. The Commonwealth Government requires every box of butter exported to contain 56 lb. 2 oz. and such butter is always entered in the factory's record of manufacture at 56 lb.; therefore all butter packed in excess of 56 lb. 2 oz. is a direct loss and reduces the over-run. When butter is packed for local sales 56 pounds are required to be weighed into each box, and any excess on this figure also reduces the over-run.

2. **Glassware.**—Careful testing of the cream for its butter-fat content is even more important than accurate weighing. Irregularities in the test can have a far greater effect on the over-run than variations in the composition of the butter. Great care is required to see that the samples for testing are truly representative of the cream to be tested, and that they are taken correctly and kept in numerical order corresponding to the numbers entered in the weight recording book. Correct sampling is most important. For the purpose of testing, 8.8 ml. of cream is assumed to be equivalent to 9 grammes by weight. Actually the weights of individual samples of cream vary slightly with their fat content, but where the physical condition of the cream is normal these variations are not significant from the point of view of factory tests. The sample is taken in a glass pipette and transferred to a testing flask and accurate results cannot be obtained unless the full 8.8 ml. or 9 grammes is actually placed in the flask. Under factory conditions this is frequently very difficult. In the colder weather cream arrives at the

factory in a very thick condition and unless the samples for testing are heated before the cream is pipetted and the residue of cream in the pipette is flushed into the flask with hot water it is unlikely that the full amount will go into the flask. Very often cream from farms where efficient methods of dairy hygiene are not practised becomes contaminated with organisms which cause a fermented or gassy condition, as a result of which minute bubbles occur throughout the mass of the cream. It is impossible to sample such cream accurately with a pipette. The tester fills his pipette to the 8.8 ml. mark, but owing to the gassy condition of the cream a large proportion of the contents of the pipette consists of bubbles and he has much less than 9 grammes by weight of actual cream. Cream in a very gassy condition should be sampled by weighing and not by pipetting. The degree of error which can occur with inefficient sampling is very considerable. Taking 100 lb. of cream with a test of 40 per cent. as a basis, the following table illustrates this point :—

Amount of Sample.		Test Read as.	Commercial Butter (from Chart).	Corrected Test Reading.	Corrected Quantity Commercial Butter	Error in Commercial Butter.
ml.	g.	Per Cent.	Lb.	Per Cent.	Lb.	Lb.
8·8	9	40	48·9	40	48·9	..
8·6	8·84	40	48·9	41	50·2	1·3
8·4	8·6	40	48·9	42	51·4	2·5
8·2	8·39	40	48·9	43	52·7	3·8
8·0	8·18	40	48·9	44	53·9	5·0

The remedy for this lies partly with the factory and partly with the supplier. The tester at the factory should take care to warm his samples and flush out his pipette carefully, but the supplier can help also by supplying cream in choice condition. It will readily be seen that apart from the lower rate paid for second grade cream the supplier can penalise himself very heavily by supplying cream in a gassy condition which renders it difficult to sample accurately. Careful attention to dairy hygiene will eliminate this trouble. During the colder months it is advisable for suppliers to send cream to the factory with a lower fat percentage than during the summer months, as such cream does not thicken as much as cream with a high test. The fat percentage in the cream can be varied by adjustment of the cream screw in the separator bowl. The Dairy Produce Acts permit cream to be supplied during the months from April to September with a fat content as low as 34 per cent., whereas the minimum permitted for the warmer months is 38 per cent. The technique of testing should be carried out efficiently and the fat column in the finished test should be bright and clear. Too much or too strong acid, resulting in burning of the fat, will cause a low reading of the test, while too little or too weak acid will cause a high reading.

Incorrect temperatures will have a similar effect. The pipette is calibrated to deliver a volume of 8.8 ml. at 70 deg. F. It is the usual practice in factories to warm the samples up prior to pipetting, and should the samples be abnormally high in temperature at the time of pipetting the volume of cream representing 8.8 ml. in the pipette will weigh considerably less than 9 grammes due to the expansion of the fat

globules and an incorrect test will result. Similarly when the test is completed and ready for reading a temperature of 140 deg. F. should be maintained for correct results. Should the temperature of the fat column be lower than that there is a contraction of its volume, which could give a lower reading than normal. The fat column should be read quickly on removal of the testing flasks from the centrifuge and the full reading according to the Dairy Produce Acts given, i.e., from the bottom of the fat column to the top of the meniscus. Should the reading be taken from the bottom of the fat column to the bottom of the meniscus an error in the reading of approximately 1 deg. will occur, a test of 40 per cent. for example being read as 39 per cent.

Errors of this type affect the estimate of manufacture and consequently the over-run in the same way as faulty weighings. Care should be taken to see that all glassware used in testing has been approved by the Department of Agriculture and Stock. Such approval is indicated by the symbols D $\overset{Q}{\uparrow}$ A on the glass. Faulty or broken glassware should be discarded. Broken-tipped pipettes or broken-necked testing flasks can cause irregularities in testing which will affect the over-run.

3. **Factory Practices.**—All factory operations should be carried out with care. Losses of cream after weighing through spillage and carelessness have a direct bearing on the over-run, as in such circumstances less cream is available for churning and the quantity of butter actually manufactured will be lowered. Careless handling in this way may even bring about an under-run. Slovenly methods of performing the operations of neutralization, pasteurization, and butter-making can adversely affect the over-run; e.g., churning at high temperature, or shortly after pasteurization, incomplete churning, and churning to a very small grain raise the fat losses; while inefficient packing and failure to salvage butter adhering to the inside of churns and to barrows and packing machines cause serious losses of the finished product.

4. **Butter Composition.**—Faulty butter composition, low moisture and salt content and loss of salt also affect the over-run. The composition of the butter is an important factor in the manufacture of the product and has an important bearing on the over-run.

The following chart is given as an example:—

SHOWING HOW WATER AND SALT AFFECT THE COMPOSITION OF BUTTER AND FACTORY RETURNS FROM BUTTER SALES.

Analysis of Butter.				Annual Output.		Gross Receipts from Butter Sales.		Receipts per Lb. Fat.	
Water. %	Salt. %	Curd. %	Fat. %	Fat. lb.	Butter. lb.	At 165/- Cwt. £	At 200/- Cwt. £	At 165/- Cwt. Pence.	At 200/- Cwt. Pence.
15·7	1·5	0·8	82·0	820	1,000	165,000	200,000	21·56	26·13
15·2	1·0	0·8	83·0	820	987·95	163,012	197,590	21·30	25·82
14·5	0·7	0·8	84·0	820	976·19	161,071	195,238	21·05	25·51

This table has been prepared to illustrate the way in which inefficient water and salt control can cause serious losses. The first section of the table shows the high percentage of fat in butters which have low percentages of water and salt. While the position has markedly improved

in the course of the last three or four years, it is unfortunately true that butters containing over 83 per cent.—sometimes as much as 84 per cent.—of fat are still being marketed. The second section of the table shows the quantity of butter which would be manufactured in each case from a basic figure of 820 tons of fat. It will be noted here that when butter containing 84 per cent. of fat is produced, the quantity of butter made is 24 tons less than if it contained 82 per cent. of fat. The effect of this on the gross receipts from butter sales is shown in the third section, where it will be seen that at 165s. per cwt. the monetary loss amounts to £3,928, while at 200s. per cwt. the loss amounts to £4,762. The fourth section of the table shows the figures from the third section reduced to receipts per lb. of fat sold. It will be observed that the loss due to lower water and salt content amounts to one half-penny per lb. of fat at 165s. cwt. and three-fifths of a penny per lb. at 200s. per cwt.

Loss of salt is a factor contributing in some measure to high fat percentages and low over-run. There is no reason why salt should be added to the churn and portion of it then drained or "washed" out. Admittedly, salt is not expensive, but the cumulative losses of salt over a year can amount to a very considerable sum. For example, in a factory producing 1,000 tons of butter a year, where salt is added at the rate of 2 per cent. of the butter, 20 tons of salt are used. If a quarter of this salt were lost the loss would be 5 tons a year, the approximate value of which would be £50, a loss of nearly £1 a week.

5. **Factory Equipment.**—All factory equipment should be maintained in first class condition, as leaking joints in pipelines, leaking churn doors, faulty butter milk strainers and bad pat butter cutters cause losses which affect the factory efficiency and over-run.

Amount of Over-run.

It has been shown that the principal factors affecting over-run are efficient weighing, sampling and testing of the cream and the percentage of water and salt in the finished product although other factors have some influence on it. The supplier will naturally be interested in the percentage of over-run which he can expect in normal circumstances. Generally speaking the over-run should not be more than 3%. If it exceeds 3% the weights and/or the tests of cream recorded are low or the butter is being marketed with more than the percentage of water permitted by law. If it is unduly low or an under run occurs, the weights and/or the tests of cream recorded are high or inefficiency in the factory is causing losses in manufacture either by actual losses of butter or by marketing butter with a low percentage of water. It must be mentioned however that it is frequently impracticable for a factory which does a considerable trade in fresh cream to show any over-run or if one is shown it will be very low.

Summary.

It will be apparent that a high over-run does not necessarily indicate greater factory efficiency. Except where it is the result of careful attention to the composition of the butter resulting in high water and salt content, a high over-run in fact usually indicates inefficiency in weighing and testing the cream when received. It must be realised, of course, that testing in factories cannot be expected to reach laboratory standards of accuracy but it is felt that this matter of accuracy deserves much more consideration than it appears to receive in some factories, especially in

regard to the technique of sampling. With regard to weighing, both of the cream when received and of the butter when being packed, the responsibility for accuracy lies with the factory staff. In this connection a word might be said about the packing of butter for export. The regulations of the Department of Commerce and Agriculture require that at least 56 lb. 2 oz. be packed into every box of butter for export. Factory managers should ascertain the minimum quantity which is required to ensure that the box contains this weight at the port of shipment. If a factory packing 20,000 boxes per annum weighs only one ounce more than is necessary into each box, its loss on one year's operations from this cause alone would be more than half a ton of butter.

Losses of fat in churning can be considerable. Investigation has shown that in some cases over two per cent. of the fat in the churn has been lost in the butter-milk. Frequent tests of the butter-milk should be a regular feature of factory routine and where losses of fat appear to be unduly high a careful study of pasteurizing and churning technique should be made.

When world industry is on a normal footing again, butter is likely to encounter serious competition from other edible fats and the greater the efficiency of the industry the better able will it be to hold its place.

Secretion of Milk.

Contributed by the Division of Dairying.

Introduction.

THE practical importance of the milk of the cow makes a knowledge of her udder more important than an understanding of that of any other species. The monotony mentally associated with the act of milking almost universally inhibits thought about the wonder of milk formation. Yet competent authorities have established that a sympathetic insight into the operation of the udder can improve the production of milk by at least 10 per cent. and of the butterfat content by up to 40 per cent.

Structure of the Udder.

1. *Exterior of the Udder.*—The udder of the mature cow normally consists of *four functional glands*. It varies in weight from 25 to 60 lb. (exclusive of milk). This variation is due to differences in age and *lactation* as well as in the amount of *secretory and connective tissue*. The udder, being a skin gland, is not directly connected with the abdominal cavity except by the *inguinal canal*. The inguinal canal forms a potential tube about 4 inches long, through which the blood and *lymph vessels* and *nerve fibres* can leave the abdominal cavity to enter the udder of the female or the *scrotum* of the male.

The udder, though often described as being square in shape, is, in reality, more like the handle of a tea cup.

An *intramammary groove* separates the right and left halves. In some cows the fore and rear quarters are smoothly joined together, so that there is no distinct demarcation. In others, various degrees of grooving or quartering are observable.

The shape or size of the teat which drains each gland seems to bear no relationship to the shape or size of the udder.

The skin which covers the udder has little supporting action. Its function is to protect the udder, and, in addition, to prevent too much swaying of the gland when the cow is moving.

2. *Interior of the Udder.*—The udder proper is a bag of complex tissue, the greater part of which consists of a soft, spongy, greyish-pink mass made up of connective tissue, muscle, blood vessels, nerves, and fat. Above each of the four teats is a milk reservoir or cistern varying in capacity up to one-quarter pint. Small blood vessels and capillaries carry blood through every part of the organ, while numerous nerves regulate the flow of blood and the formation of milk. In addition, small, round *gland-lobules* occupy a large part of the udder. The gland-lobules are connected by tiny tubes to milk ducts and resemble grapes on a bunch. The inside of each gland-lobule is lined with a large number of microscopic bodies (*alveoli*), the walls of which are lined with from 50 to 150 *epithelial cells*, and within which milk is formed.

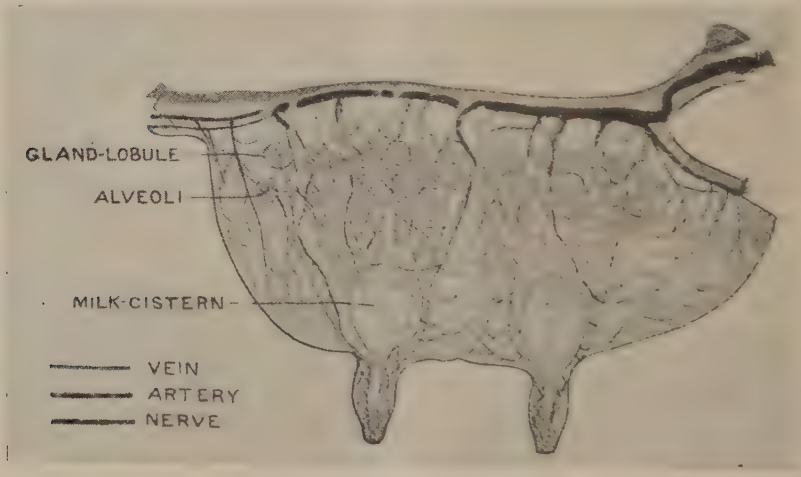


Plate 112.

A SECTION THROUGH THE UDDER.

Here these substances of which milk is composed (*precursors*) are taken from the blood plasma and passed through the neck of the lobule into a branch milk duct to a main duct and thence to the reservoir. *Sphincter muscles* placed round the teat canal below the reservoir prevent loss of milk. The canal which runs through the *sphincter* is from $\frac{1}{4}$ to $\frac{1}{2}$ in. long and is known as the *papillary duct* or *streak canal*.

A loose fold of *mucous membrane* (*Furstenberg's rosette*) at the upper end of the papillary duct reinforces the action of the sphincter in effectively blocking the escape of milk from the udder. The *streak canal*, in addition to checking the escape of milk, also serves to prevent the entrance of bacteria and other foreign materials into the gland proper.

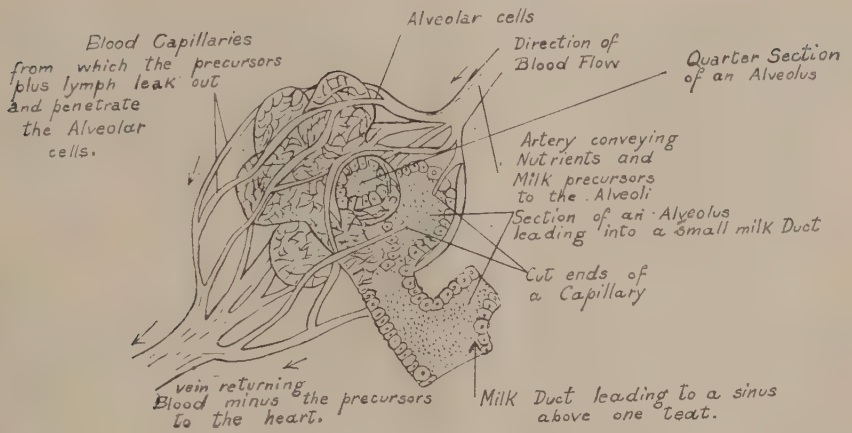

Alveolar cells
Blood Capillaries from which the precursors plus lymph leak out and penetrate the Alveolar cells.
Direction of Blood Flow
Quarter Section of an Alveolus
Artery conveying Nutrients and Milk precursors to the Alveoli
Section of an Alveolus leading into a small milk Duct
Cut ends of a Capillary
Vein returning Blood minus the precursors to the heart.
Milk Duct leading to a sinus above one teat.

Plate 113.

The foregoing diagram illustrates a bunch of secretive alveoli. Note how the blood capillaries are distributed among them. This gives an idea of the actual contact between the blood stream and the alveoli.

How Milk Secretion is Controlled.

These diagrams attempt to show how secretion is finally stopped by pressure of milk within the udder itself—(1) at fourteen hours secretion and (2) at six hours. The *alveolar cells* are flattened and distorted in the distended alveolus, which prevents secretion partly. The main cause probably is the fact that the distended alveoli compress the thinner walled veins traversing the udder tissue and so stop most of the blood flow. In these diagrams alveoli are only partly distended and no pressure is exerted on the regional veins. The varying size of the alveolar cells denotes active secretion, as some are on the point of bursting, while others have just burst and collapsed. Midway stages also occur.

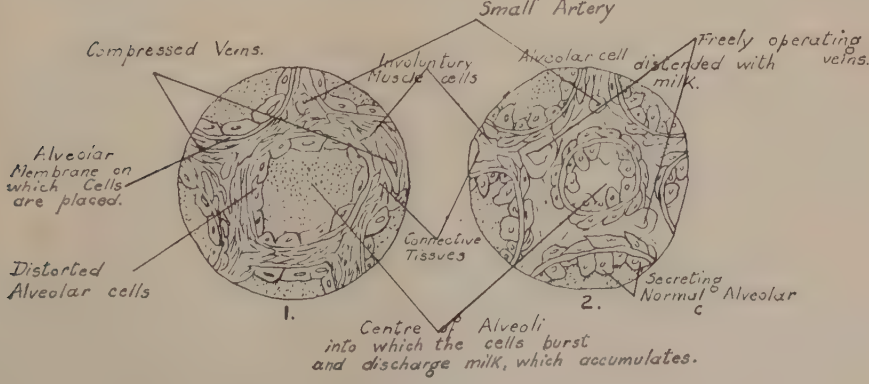


Plate 114.

Method of Secretion.

Blood circulates through the udder, and from its arterial blood vessels clear *plasma fluid* leaks out into and around the tissues carrying all the necessary precursors of milk. *Precursors* are the simple substances from which milk is derived. They are the substances which are built up into butterfat, sugar, ash and *caseinogen* in the *milk secreting epithelial cells* that line the ducts and milk pockets (*alveoli*) of the udder. This process goes on continuously and results in the extrusion of fully formed milk from the secreting cells into the ducts leading to the cisterns above the teats. The secreting cells are factories, and, at the same time, a barrier between the milk pockets and ducts on the one hand and the blood plasmas on the other.

The walls of the alveoli, the ducts, and the cisterns are elastic and muscular, but 40 per cent. of a cow's milk production can be held in them before the vessel shows signs of distention. From the sixth to the eighth hour after milking, pressure in the udder rises, the rate of milk formation slows down, and finally stops at about the twelfth to fourteenth hour in the average producer due to the pressure of the milk itself acting on the secreting cells and blood vessels. In this slowing-up period the secretion of butterfat is retarded and the tiny fat droplets tend to remain in the deeper and finer milk ducts and pockets lightly adhering to the sides; butterfat is not dissolved in milk as sugars and *proteins* are, but is suspended as tiny droplets. From experience, it is inferred that milk secretion is a continuous process and that a large proportion of the milk withdrawn at any milking is collected and stored within the gland before the milking process is commenced.

Rate of Secretion.

The pressure within the udder (*intramammary pressure*) is least immediately after milking. As the pressure of the accumulating products gradually increases there is a corresponding drop in the rate of milk formation. (See above for explanation of this phenomenon.) Though the rate of milk secretion is very difficult to estimate, some authorities state that each hour's milk production is 95 per cent. of the production of the previous hour. The percentage is probably affected by the stage of lactation and other factors. For example, it is known that considerable milk can be left in the udder of the recently fresh cow without causing any appreciable decline in milk production. Milk pressure at the base of the teat usually varies from 25 to 35 mm. of mercury. However, it may be considerably higher in fresh cows or in individual cows.

Intramammary Pressure.

The pressure which occurs before the udder is stimulated, but several hours after milking, is probably due (1) to the weight of milk in the milk cisterns, and (2) to the pressure resulting from the secretion of milk. The pressure may vary markedly with the type of udder, but it usually bears a close relationship to the productivity of the cow.

Difference in Composition of First and Last Drawn Milk.

Normally, the milk first drawn from the udder contains less fat than the last drawn milk. Many theories have been advanced to explain this phenomenon. That of Turner seems to offer the most satisfactory explanation. He suggests that the pressure of the accumulating milk in the udder results in the large fat globules being retained in the

secretory cells of the alveoli. The water and soluble substances which escape more easily, collect in the *lumina* of the alveoli, and thereby offer resistance to the emptying of the secretory cells. The fat globules thus tend to escape less readily as the pressure increases. The "creaming theory" which has been very popular over a long period is no longer regarded as being tenable for a number of reasons which it is not intended to discuss here.

"Letting Down."

One of the most intriguing problems for the milker is the manner in which the cow "holds up" or "lets down" her milk. "Letting down" of milk is brought about by the contraction of muscle fibres around the ducts and cisterns; and even the alveoli have muscle fibres which contract them to a smaller sphere. These muscles are controlled by nerves belonging to the *sympathetic system*, over which the cow has only indirect control. When the nerve endings in the teat are stimulated, the stimuli are carried by the nerves to a small gland (*the pituitary gland*) at the base of the brain. As a result of this stimulus a *hormone* (*oxytocin*) is secreted by the pituitary gland into the blood stream which carries it to the udder, where the hormone causes the muscle fibres around the *milk-secreting sacs* to contract. At this stage flow of milk becomes rapid. All the milk should be removed as rapidly as possible, because the muscle fibres around the alveoli soon become fatigued and relax after six to seven minutes. Observance of the following simple rules stimulates "let down":—

(1) Warm water udder washes one minute prior to milking.

(2) Rapid milking in from three to four minutes per cow.

(3) Complete milking.

Stimulation of the "letting down" process also depends upon the cow's receiving an habitual and congenial association of ideas at each milking time. The sucking of teats by the calf is a natural stimulus to the "letting down" of milk by the cow. The manipulation of the teats by the milker becomes associated with this conditioned reflex. The cow may thus be quite easily conditioned to a pair of strong but kind hands rapidly drawing the milk down, coupled with a confident attitude of the milker towards the cow. Fear and excitement result in secretion of *adrenalin* by the adrenal gland, which inhibits contraction of muscle fibres around the milk secreting sacs and consequently the cow "holds up" her milk.

Conditioned reflexes help to explain why regularity in feeding and milking pays.

Acknowledgment.

In the compilation of this article the standard works of Espe, Petersen, and others have been freely consulted.

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PRODUCTION RECORDING.

List of cows and heifers officially tested by Officers of the Department of Agriculture and Stock, which qualified for entry into the advanced register of the A.I.S., Jersey, Ayrshire and Guernsey Societies' Herd Books, production records for which have been compiled during the month of April, 1948. (273 days unless otherwise stated).

Animal.	Owner.	Milk Production.	Butter Fat.	Sire.
		Lb.	Lb.	
AUSTRALIAN ILLAWARRA SHORTHORN.				
Mature (Standard 350 lb.).				
Sunnyview Evelyn 9th	J. Phillips, Wondai	13,056·75	530·98	Sunnyvale Monarch
Trevor Hill Dove 2nd (231 days)	G. Gwynne, Umbiram	10,474·80	466·839	Corunna Supreme
Roshill Queenie 4th	W. Flesser, Boyland	12,294·90	463·323	Dnalwon Felix
Merridale Dimple	Giles Bros., Woowonga	11,692·1	450·247	Blacklands Heir
Blacklands Joan 8th (229 days)	A. Pickels, Proston	9,504·8	440·163	Blacklands Sultan 2nd
Junior, 4 Years (Standard 310 lb.).				
Greyleigh Gem 196th	W. H. Thompson, Nanango	12,877·25	470·615	Greyleigh Wootan
Senior, 3 Years (Standard 290 lb.).				
Valera Roseleaf 16th	Sullivan Bros., Pittsworth	14,527·51	585·617	Alfa Vale Pride 2nd
Valera Roseleaf 17th (191 days)	Sullivan Bros., Pittsworth	8,048	325·622	Alfa Vale Pride 2nd
Blacklands Joan 10th	A. Pickels, Proston	7,858·55	316·101	Blacklands Maiden's Monarch
Junior, 3 Years (Standard 270 lb.).				
Blacklands Foremost 42nd	A. Pickels, Proston	8,358·1	320·97	Blacklands Maiden's Monarch
Senior, 2 Years (Standard 250 lb.).				
Valera Una 5th	Sullivan Bros., Pittsworth	9,459·89	415·151	Alfa Vale Pride 2nd
Alfa Vale Star 15th	W. H. Thompson, Nanango	9,876·45	411·814	Alfa Vale Stalin
Yarranvale Bounce	K. A. Ruhle, Motley	7,056·1	266·963	Alfa Vale Pride 10th
Merrivale Rosebud 2nd	Estate W. Soley, Malanda	7,066·2	255·818	Greyleigh Mosstrooper
Junior, 2 Years (Standard 230 lb.).				
Trevor Hill Twinkle 4th	G. Gwynne, Umbiram	7,983	325·156	Trevor Hill Bosca
Roshill Almond 6th	W. Flesser, Boyland	7,730	268·125	Dnalwon Felix
Yarranvale Joyful	K. A. Ruhle, Motley	6,838·3	251·879	Yarranvale Prospector
AYRSHIRE.				
Mature (Standard 350 lb.).				
Fairhill Butterfly	M. J. Brownlie, Nangwee	9,556·45	448·678	Fairhill Royal Laddie

JERSEY.

MATURE (STANDARD 350 LB.).

Brookland Cunning Drop	W. S. Conachie, Sherwood	12,800·4	752·253	Englorie Cunning Victor
Brookland Rosemond	W. S. Conachie, Sherwood	10,340·5	512·24	Brookland Sultan's Rostrum
Windsor Lady Gladys	H. G. Johnson, Beaudesert	10,318·75	511·523	Brookland Sultan's Victory
Brookland Gold Leaf	W. S. Conachie, Sherwood	8,607·15	498·126	Brookland Gold Standard
Inverlaw Sirius (365 days)	R. Crawford & Sons, Kingaroy	9,033·85	474·755	Oxford Royal Lad
Gem Aster	W. Bishop, Kenmore	8,891·65	442·983	Calton Lothean
Sylvale Brown Succeed	A. Semgreen, Coolabunia	9,134·6	420·279	Oxford Brown Lad
Glenrandle Golden Girl	P. Kerlin, Killarney	7,229·2	411·037	Bellgarth Stylish
Romsey Dainty Rose	J. Wilton, Killarney	7,412·8	410·888	Oxford Dainty Peer
Romsey Skylark	J. Wilton, Killarney	6,645·8	384·319	Romsey Bright Boy

SENIOR, 4 YEARS (STANDARD 330 LB.).

Boree Cute Comedy	W. and C. E. Tudor, Gayndah	8,457·82	411·41	Trinity Cute Commodore

JUNIOR, 4 YEARS (STANDARD 310 LB.).

Nairfale Lady Laura	R. J. Browne, Yangan	7,780·5	414·937	Nairfale Noble Count
Romsey Countess 2nd	J. Wilton, Killarney	7,329·1	403·879	Romsey Golden Victor
Nairfale Brown Belle	R. J. Browne, Yangan	7,686·9	387·453	Nairfale Count's Prominence
Gem Glamour Girl	V. Bishop, Kenmore	8,269·55	373·101	Calton Lothean
Glenrandle Luna	M. J. Kerlin, Killarney	6,334	371·849	Bellgarth Stylish
Grasmere Victorius Dove	F. Z. Eager, Neurum	6,407·1	342·791	Navua Victorious Samaritan

SENIOR, 3 YEARS (STANDARD 290 LB.).

Glenview Golden Eblis	F. Z. Eager, Petrie	6,492·05	353·907	Trinity Governor's Hope
Tecoma Petal	A. Semgreen, Coolabunia	5,819·7	319·751	Trinity Golden Royal

JUNIOR, 3 YEARS (STANDARD 270 LB.).

Tecoma Brown Lass	A. Semgreen, Coolabunia	7,052·2	409·219	Trinity Golden Royal

SENIOR, 2 YEARS (STANDARD 250 LB.).

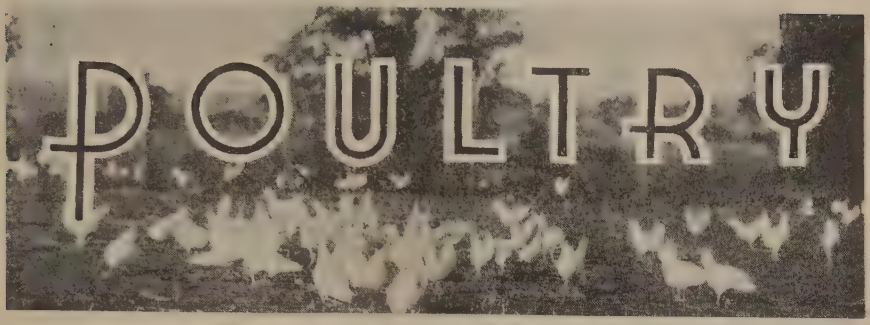
Ellerdale Gamboge Tidy	A. L. Dahl, Taragoola	7,244·7	390·593	Ellerdale Prince's Gamboge
Inverlaw White Star	R. J. Crawford & Sons, Kingaroy	5,669·5	335·233	Oxford Royal Lad
Delrose Melba	F. C. Leschke, Wanora	6,082·50	323·473	Oxford Erin's Victor II.
Lermont Madeira 3rd	J. S. McCarthy, Greenmount	5,725·6	318·543	Trinity Noble Effort
Grasmere Victorious Pontorson	F. Z. Eager; Petrie	6,090·7	316·723	Oxford Brown Victory
Kinross Vida	H. R. Randall, Woowoonga	5,540·1	282·666	Kinross Jester
Romsay Pam	J. Wilton, Killarney	4,681·3	277·592	Oxford Pixie's Victor

JUNIOR, 2 YEARS (STANDARD 230 LB.).

Brookland Merry Rosanna	W. S. Conachie, Sherwood	7,196·45	417·448	Brookland Maria's Keepsake
Romsey Bonnie Beauty	J. Wilton, Killarney	7,534·5	397·343	Bellgarth Lancer 3rd

Production Recording—*continued.*

Animal.	Owner.	Milk Production.	Butter Fat.	Sire.
		Lb.	Lb.	
JERSEY—*continued.*				
JUNIOR, 2 YEARS (STANDARD 230 LB.).				
Glenrandle Lottie	P. Kerlin, Killarney	6,047·5	347·698	Bellgarth Glory King 2nd
Brookland Regal Maid	W. S. Conochie, Sherwood	5,703·1	325·037	Brookland Regalia
Myrtledale Sybil	H. Sigley, Jaggan	5,258·4	323·033	Palm Ridges Golden Symbol
Somersley Pixie Lass	H. R. Randall, Woowoonga	6,960·7	313·837	Trinity Dreaming Lad
Grasmere Victorious Ermington	F. Z. Eager, Petrie	5,702·2	288·809	Navua Victorious Samaritan
Inverlaw Comic	R. J. Crawford & Sons, Kingaroy	5,151·05	256·892	Oxford Royal Lad
Grasmere Victorious Brittania	F. Z. Eager, Neurum	5,144·95	254·430	Navua Victorious Samaritan
Inverlaw Royal Petal	R. J. Crawford & Sons, Kingaroy	4,984·45	253·331	Oxford Royal Lad
Wavemere Rosemary	A. L. Dahl, Taragoola	4,939·7	251·921	Oxford Mighty Ajax
Myrtledale Cedar (228 days)	C. J. McKell, Jaggan	3,875·65	244·193	Oxford Remys Count
GUERNSEY.				
MATURE (STANDARD 350 LB.).				
Laureldale Mirabel's Patch	W. A. K. Cooke, Witta, Maleny	12,124·7	550·87	Laureldale President
JUNIOR, 3 YEARS (STANDARD 270 LB.).				
Laureldale Pamela (365 days)	W. A. K. Cooke, Witta, Maleny	11,698·4	569·049	Minna Murra Topsy's Sequel
Bungalow Vale Vanity Fair 3rd	W. A. K. Cooke, Witta, Maleny	9,663·9	464·883	Yarraview Factor



Health in the Hatchery.

P. RUMBALL.*

WITH higher costs of production and the need to build up the poultry flocks of this State to permit of increased exports of eggs and poultry meat to Great Britain, hatchery owners and those engaged in the rearing of chickens should review last season's operations with the object of doing better, if possible, during the coming hatching season.

Packed within the fertile egg should be all the essentials for the hatching of a healthy vigorous chicken. This, however, depends on the health of the hen and the ration fed.

A Cause of Chicken Mortality.

Pullorum disease, the most serious chicken disease, is at times the cause of heavy chicken mortality. It is transmitted from parent to offspring through the egg. The parent may not look unhealthy, and the only method of determining whether a bird is infected or not is by a blood test. Hatchery owners in collaboration with the Department of Agriculture and Stock have done much to ensure that the hatching of chickens should be reasonably free from pullorum disease. Almost a quarter of a million breeding birds will have been tested for hatchery owners by officers of the Department by the end of June. This is about 30,000 more than were tested last year, consequently a greater output of chickens during the coming season may be expected.

Protection from Infection.

The blood testing of breeding birds, however, is only one factor in the control of this disease, and hatchery owners should follow up their good work and protect chickens from infection from other sources. These other sources are infected incubators, chicken boxes, and brooders. All the plant used in the hatching and rearing of chickens should first be thoroughly cleansed and then disinfected. Disinfection is of little use without the cleansing process. During the season the machine and fittings at hatching time become soiled. The cleansing

* In a *Country Hour* broadcast from 4QG and published by courtesy of the Australian Broadcasting Commission.

and disinfection should follow each hatch. With many types of incubators, disinfection is somewhat difficult and fumigation is necessary. To those unfamiliar with the process of fumigation it is recommended that they consult departmental advisers, but it is little use fumigating incubators and egg trays to which masses of excreta or egg material are adhering without such trays being first thoroughly cleansed, as the gas cannot penetrate the solid masses sometimes seen in incubators.

Importance of Correct Feeding.

The nutrition of the parent bird is most important. Without correct nutrition, that percentage of hatched chickens which makes for economy of production is not obtained, nor are those that are hatched as strong and lusty as they should be.

Many are of the opinion that if the birds are laying well they are being correctly fed, but this is not so if the eggs are to be used for hatching. It has been definitely determined that for good hatchability greater quantities of vitamin A and B2 (riboflavin) have to be available to the birds if satisfactory egg production is to be obtained.

The cheapest source of vitamin A is green feed. Chaffed green lucerne, oats, barley, and rape are good sources of this vitamin. Unfortunately, green feed is generally in short supply during the breeding season. A good grain source is yellow maize, but to supply breeding birds with all the vitamin A they require through maize the whole ration would have to consist of this grain. This system of feeding would not permit of economy in production of the eggs required, consequently fish oils or vitaminized emulsions are usually included in the breeders' rations to assure a sufficiency of vitamin A. Hatchery owners who cannot supply all the succulent greens that their birds will consume are therefore recommended to use vitaminized preparations and, as these are not all of the same potency, to use them as directed by the vendor. With baby chickens vitaminized preparations are almost essential, particularly if the ration is largely composed of white grains, as young chickens have not the capacity to consume green feed in quantity to ensure them against a vitamin A deficiency.

Vitamin B2 or riboflavin is equally as important for the prevention of the loss of chickens dead in shell. Green feed is again a good source of supply but the best available sources are milk powders and liver meals. The inclusion of about 4 per cent. of buttermilk powder or about 3 per cent. of liver meal in the mashes supplied to breeding stock, in addition to what is supplied by the other ingredients of the ration, will ensure a sufficiency of riboflavin.

The need for a sufficiency of vitamins A and B2 cannot be too strongly stressed, both for breeding birds and growing stock. During the 1945 hatching season a survey of some hatcheries in localities near Brisbane was made. The average hatchability of all eggs set in 17 of the better-fed groups of birds was 72 per cent. while, in 9 groups of those upon a poor plane of nutrition, the hatchability was as low as 45 per cent. During the 1947 season, several cases of a deficiency of one or both of these vitamins came under our notice.

Manganese Deficiency.

There is another deficiency that hatchery owners might experience in districts where bran and pollard are not readily available, and that is manganese. A shortage of this mineral is a cause of an increased percentage of crippled chickens and poor egg shell quality. Whole grains are not a good source of supply, maize being particularly poor. The shortage can be overcome by the addition of commercial manganese sulphate to the ration at the rate of 4 ounces to the ton. The best method of incorporating this in the mash is to first add 4 ounces of manganese sulphate to 20 lb. of salt and to add 1 per cent. of this manganese sulphate salt mixture to the mash. The use of manganese sulphate is recommended in all districts where maize forms the greater part of poultry rations.

Early Action Necessary.

The present hatchery capacity of Queensland is approximately $1\frac{3}{4}$ million eggs every three weeks. The loss of chickens that could occur through the improper nutrition of even a small proportion of our breeding flocks could therefore be enormous.

Poor hatching caused by incorrect feeding can be corrected fairly rapidly and hatchery owners experiencing this trouble should contact a poultry adviser of the Department of Agriculture and Stock as early as possible in the season.

CLEAN-EGG NEST.

A South Australian has won £25 for inventing a hen's nest which will keep eggs clean.

His design was entered in a competition conducted by the Australian Egg Producers' Council when the British Ministry of Food decided to accept only unwashed eggs from Australia, after tracing deterioration in transit to the practice of washing eggs after collection from the nests.

The competition attracted elaborate and weird inventions. One had gear-wheels, a conveyor belt, and a drawbridge. But the prize-winning nest was simple. The floor of the nest is of fine mesh wire netting, tightly stretched and having a slope to one side. Straw is packed underneath the netting for warmth. The egg, when laid, rolls into a receptacle at one side where it is safe from the hen's muddy feet.

FEEDING OF POULTRY.

At the present time economy in the feeding of poultry is particularly necessary, but much wastage of food occurs on many farms. Common causes of such waste are faulty dry feed hoppers, lack of suitable troughs for feeding wet mash, over-feeding, and unsuitable facilities for the storage of food. It can be prevented in the following ways:—

If dry mash is fed the hopper should be so constructed that the food cannot be scratched out by the birds.

Where wet mash is fed it is necessary to provide sufficient troughs of a suitable type. These can be made of galvanised iron or wood.

To avoid waste by over-feeding the birds should be given only as much feed as they will consume within about an hour of feeding.

Suitable storage bins should be provided so that a number of bags of the different classes of foodstuffs can be emptied into the bins, thus saving the wastage which mostly occurs when the feed is taken from the bags as required.

Junior Farmers' School.

THE first of a series of special schools of instruction for members of Junior Farmers' Clubs was held at the Queensland Agricultural High School and College from 27th April to 7th May under the direction of the State Organiser, Mr. T. L. Williams.

Boys selected for the course were representative of clubs in various parts of the State. Enrolments were:—

Darling Downs.—Denis B. Doyle, Clinton Vale, Warwick; John K. McDonnell, Greymare, Warwick; Gordon T. McLennan, Willowvale, Warwick; Beres Eastwell, Willowvale, Warwick; Gordon T. Reid, Willowvale, Warwick; Michael J. Rossiter, Wild-Ash, Warwick; Edward W. Cooper, Murray's Bridge, Warwick; Kevin P. Cooper, Murray's Bridge, Warwick; Vincent G. Nicholls, Pratten, *via* Cunningham; Benjamin R. Walsh, Goombi, *via* Chinchilla; Edward Chapman, Greenmount; Thomas A. Smooth, Pinelands, Crow's Nest; Reginald C. Blanck, Ravensbourne, Toowoomba; William McConnell, Milmerran; Stanley T. Fowler, Pittsworth; Colin A. Cornford, Pittsworth; William J. Sullivan, Pittsworth; John R. Wanka, Pittsworth; Francis A. Rowen, Pittsworth; William J. Grayson, Killarney; Laurence R. Brunton, Killarney; Reginald O. Madsen, Yangan.

Lockyer.—John D. Brooks, Lilydale, *via* Helidon; Sydney S. Sticklen, Lilydale, *via* Helidon; John R. Sticklen, Lilydale, *via* Helidon.

Beaudesert.—Raymond R. Hopkins, Woodhill, *via* Beaudesert.

Wide Bay.—Leo R. Jones, Kilkivan.

South Burnett.—William F. Silburn, Goomeri.

Central Burnett.—William R. Foster, Coalstoun Lakes, *via* Biggenden; Stanley R. Hunter, Coalstoun Lakes, *via* Biggenden.

Plate 115.

FIRST QUEENSLAND JUNIOR FARMERS' CLUB SCHOOL, APRIL-MAY, 1948.

Sitting (left to right): B. R. Walsh, J. K. McDonnell, J. R. Wanka, T. A. Smoothy, T. L. Williams (State Director, Junior Farmers' Organisation), S. T. Fowler, L. R. Jones, E. Chapman, W. J. Sullivan.

Standing (left to right): W. R. Foster, R. O. Madsen, G. T. Reid, S. W. Sticklen, G. T. McLennan, J. D. Brooks, D. B. Doyle, W. McConnell, W. F. Silburn, F. A. Rowen, V. G. Nicholls, R. C. Blanck.

Plate 116.
JUNIOR FARMERS NOTING THE POINTS OF A JERSEY HEIFER.

In co-operation with the Department of Public Instruction, the Department of Agriculture and Stock assisted with the arrangements and supplied lecturers for the course. The syllabus included the following:—

Plant Industry.—"Soil Science," by W. J. Cartmill, Senior Soils Technologist; "Silo Construction and Silage," by W. H. Bechtel, Chief Adviser in Agriculture; "Soil Conservation," by A. F. Skinner, Soil and Conservation Officer, Bureau of Investigation of Land and Water Resources.

Animal Industry.—"Pig Raising," by E. L. Melville, Adviser, Pig Branch; "Poultry Breeding and Feeding," by F. N. J. Milne, Assistant Husbandry Officer; "Animal and Poultry Diseases—Causes and Remedies," by K. M. Grant, Veterinary Officer.

Dairying.—"Herd Production and Recording," by S. E. Pegg, Senior Dairy Adviser (Herd Testing); "Milking Machines and Separators," by E. Sutherland, Dairy Adviser (Machinery).

Plate 117.

JUNIOR FARMERS LEARNING THE "HOW" AND "WHY" OF MACHINERY OPERATION.

In the evening sessions, documentary films covering a wide range of rural interest and education were screened and the theme of each motion picture formed the subject of subsequent discussion.

Although wet weather upset arrangements for some field demonstrations, the first school of instruction for junior farmers was a complete success, and as the Junior Farmers' Club Movement extends many similar schools will be held.

Junior Farmers for Britain.

Three members of Junior Farm Clubs are on their way to England on the R.M.S. "*Orion*" to compete in the International Stock Judging Competition at this year's Royal Show to be held at York. The boys are Ken. Henry, of the Numbaa Junior Farmers' Club, Nowra (New South Wales); Jack Martin, of the Albion Park Junior Farmers' Club (New South Wales); and Allan Turner, of the Kiewa Valley Junior Farmers' Club (Victoria). These boys were selected from a large number of nominations from many parts of the Southern States where the Junior Farmers' Club organisation is now firmly established. Next year it is hoped that Queensland will be represented among the junior farmers selected to travel abroad on similar educational tours.

Plate 118.
LEARNING THE POINTS OF A GOOD HORSE.

Plate 119.
HOW OLD IS HE? Junior farmers getting the tip right from the horse's mouth.

MARKETING

Production Trends—April.

Dairy cattle are in good condition and production generally is being well maintained. As a result of cooler weather, the quality of milk and cream supplies is improving.

Sowing of wheat, barley and oats is proceeding on the Darling Downs.

Late planted crops of maize and grain sorghum are still being harvested.

A heavy sugar crop is in prospect in the far north, where showery conditions throughout April were sufficient to keep crops growing, and provided excellent planting conditions. Conditions are also good in the Mackay district, where crops are expected to be better than for several preceding years.

Harvesting of the cotton crop continued during April until interrupted by heavy rains towards the end of the month. The Rust mechanical picker is at present operating in the South Burnett, and reports indicate very satisfactory results.

With the exception of falls experienced in the northern and southern coastal sectors towards the latter end of April, dry conditions prevailed throughout the pastoral areas. Feed generally is dry, and in some areas extremely scarce, whilst surface waters are rapidly disappearing.

Sugar Prices.

The Acting Minister for Agriculture and Stock, Mr. D. A. Gledson, stated recently that he had received from the Sugar Board a declaration made in accordance with clause 10 of the Proclamation of 12th June, 1947, that the proportion of 1947 season Queensland sugar deemed to have been delivered for home consumption was 85.8132 per cent. of the production, exclusive of "excess" sugar, and that the net value of surplus sugar was determined at £29 12s. 6d. per ton 94 net titre. In respect to home consumption sugar under clause 8 of the Proclamation the price had been declared at £24 per ton 94 net titre.

The average price represented by the foregoing is £24 16s. per ton for sugar within the peak. The final payment is to be made on 31st May for sugar delivered by that date; and payment will be made as soon as possible after delivery in respect to the balance of the sugar.

Mr. Gledson said that the expenses of the Sugar Board in marketing sugar are expected to increase very considerably for the 1948 season, because of sharply increased jute prices and the general disturbed conditions and rising costs.

Protracted delays in the transport of sugar from Queensland ports to refineries cause considerable loss, because of the deterioration of the sugar and the bags, extra handling costs, and refining difficulties.

Brisbane Wholesale Markets.

April saw the peak of the marketing of apples, pears and grapes from the Granite Belt. By the end of the month consignments to Brisbane had declined appreciably. The general quality of these fruits was good and growers found a favourable market.

Quantities of bananas and pineapples marketed were much below those of recent months. Wholesale prices advanced.

There was a good demand for lucerne chaff from local and near country districts and average prices for the month were high at approximately £12 per ton. The settlement of the rail strike allowed consignments to be made to more distant areas. For this latter purpose up to £17 per ton was paid for some lines of prime dry green leafy lucerne chaff.

Potato Marketing.

The meeting of the Federal Potato Advisory Committee in Brisbane on 29th April gave representatives from each State the opportunity to go to work on the marketing problems which will face the industry when "The National Security (Potatoes) Regulations" are revoked on 31st October next.

The main difficulty is that in two States, Tasmania and South Australia, no complete legislative framework yet exists on which statutory Potato Marketing Boards could be built. Added to this is the lack of concurrence among the States on the question of the regulation of acreage.

However, there was a general feeling at the meeting that members had come much nearer to a common view point, and the Committee unanimously approved a plan which it considered would implement the orderly marketing of potatoes after Commonwealth control has ceased. If this plan is adopted by all the States Organisations it will be presented to the Minister for Commerce and Agriculture for his consideration.

Proposed Tobacco Leaf Marketing Board.

The Minister for Agriculture and Stock, Mr. H. H. Collins, has announced that there would be no referendum on the question as to whether the *Primary Producers' Organisation and Marketing Acts* would be extended to tobacco leaf, and a tobacco leaf marketing Board set up accordingly. Objections lodged at the Department did not conform with the requirements of the Act for a ballot since they did not contain the requisite number of names of registered tobacco-growers.

The following nominations of candidates for election as growers' representatives on the Board have been received by the Returning Officer:—

District No. 1 (Northern)—

Gilmore, Thomas Vernon, Emerald Creek, Mareeba.
Short, Edgar Harry, Dimbulah.

District No. 2 (Southern)—

Doljanin, Ivon, Whetstone.
Donges, Jacob, Glenarbon, Yelarbon.
Golding, Francis Robert Eldridge, Miriam Vale.
Mayne, Walter Herbert, Colburn, Texas.
Power, John Lawrence, Stanley street, South Brisbane.
Ziviani, Renzo, Inglewood.

As two growers' representatives are to be elected from each of the two districts, Messrs. Gilmore and Short have been elected unopposed for District No. 1.

An election will be necessary for District No. 2. Ballot-papers have been despatched to growers on the roll for that District; the election will be held on the 13th July.

QUEENSLAND SHOW DATES, 1948.

Bowen	June 30–July 1	Lawnton	July 30–31
Brisbane R.N.A.	August 7–14	Lowood	June 11–12, 14
Cairns	July 20–22	Mackay	June 22–24
Cooroy	August 28	Malanda	September 3–4
Gatton	July 15–17	Nambour	July 1–3
Gladstone	June 10–12	Proserpine	June 25–26
Ingham	July 16–17	Rockhampton	June 16–19
Innisfail	July 30–31	Rosewood	July 9–10
Laidley	June 25–26	Toogoolawah	June 18–19
		Townsville	July 6–8

GENERAL NOTES

Bureau of Sugar Experiment Stations.

Mr. N. J. King, Assistant Director in the Bureau of Sugar Experiment Stations, Department of Agriculture and Stock, has been appointed to the position of Director of Sugar Experiment Stations which became vacant recently on the resignation of Mr. E. R. Behne.

Mr. L. G. Vallance, Senior Soils Technologist in the Bureau, succeeds Mr. King as Assistant Director of Sugar Experiment Stations. Mr. Vallance will go abroad shortly, where he will study methods being used in overseas countries, particularly in the tropics and sub-tropical countries, to arrest decline in soil fertility.

Queensland-British Food Corporation.

Following the secondment of Mr. C. J. McKeon, Director of Agriculture in the Department of Agriculture and Stock, to the Queensland-British Food Corporation, the Department's Assistant Director of Agriculture, Mr. D. O. Atherton, will act as Director of Agriculture during Mr. McKeon's term with the Corporation.

Banana Industry Protection Board.

Mr. N. E. H. Caldwell, Assistant Director of Horticulture, Department of Agriculture and Stock, will succeed Dr. W. A. T. Summerville (Director, Division of Plant Industry) as a representative of the Government and Chairman of The Banana Industry Protection Board.

Open Season for Duck and Quail.

Following the decision of the Government to declare an open season for duck and quail in Queensland this year, an Order in Council has been issued under *The Fauna Protection Act of* 1937 declaring an open season for wild duck (except Burdekin duck) and quail for the period from 1st July, 1948, to 30th September, 1948. This year the open season will apply throughout the State for the three months abovementioned.

The attention of shooters is drawn to an *Order in Council* which prescribes that twenty duck and twenty-five quail are the maximum numbers, respectively, which any one person may take during a period of twenty-four hours.

The Poultry Advisory Board.

The Executive Council, in pursuance of the provisions of *The Poultry Industry Act of* 1946, has approved of the constitution of the Poultry Advisory Board until 31st December, 1948. Hon. H. H. Collins, Minister for Agriculture and Stock, is Chairman of the Board, and Messrs. W. Webster, Director of the Division of Animal Industry, and P. Rumball, Officer in Charge of the Poultry Branch, represent the Department of Agriculture and Stock. In addition, the four representatives of the poultry industry are Messrs. R. B. Corbett, Chairman of the Egg Marketing Board, C. Kidd, Poultry Farmers' Co-operative Society, D. Anderson, National Utility Poultry Breeders' Association, and R. F. Phyall, Poultry Farmers' Union.

Soil Conservation Conference for Queensland.

The Minister for Agriculture (Hon. H. H. Collins) has announced that a conference of soil conservationists will be held in Brisbane on 28th May. It is expected that the conference will be attended by delegates from all States and the Commonwealth.

Mr. Collins said that his Department would take advantage of the presence of these experts in Queensland and had arranged a pre-conference visit to the Darling Downs and Burnett districts. Delegates would see the special problems of soil erosion in Queensland and the methods being developed to combat this menace, and their opinions on these methods would be freely sought. He added that while soil erosion had not reached the serious stage encountered in some other States, the menace was serious and must be faced.

Rural Topics

Fertilizer Buyers Protected.

Buyers of fertilizer for farm and home garden use are fully protected in Queensland, in so far as quality is concerned, by the Department of Agriculture and Stock. It is mandatory under the Fertilizers Act which is administered by the Department for a label to be attached to each package of fertilizer showing the percentage of each chemical it contains and the degree of fineness of the ingredients. Samples are selected periodically by inspectors and analysed so that a proper check can be maintained.

Fertilizers commonly used in Queensland are nitrate of soda from Chile; sulphate of ammonia, a by-product of gasworks and coke ovens (also manufactured by the fixation of nitrogen from the air, and often referred to as synthetic nitrogen); superphosphate, manufactured in Brisbane from Ocean and Nauru Island rock phosphate; dried blood and bone dust, meatworks by-products; sulphate of potash from Western Australia; and muriate of potash from Palestine and France.

Low Butterfat Tests in Milk.

At this time of the year many dairy farmers have difficulty with the fat test of their bulk milk. In many cases the test is below the minimum standard of 3.3 per cent.

The following recommendation, if applied, will bring about an improvement:—

1. Arrange milking intervals as near to 13 and 11 hours as possible.
2. Do not strip at the evening milking, but strip thoroughly at the morning milking.
3. Reject fore-milk from each quarter and carefully examine for mastitis.
4. Prevent water from entering milk when cleansing milking machines.
5. Keep stock in good condition by adequate feeding.
6. Milk heaviest producers last in the evening and first in the morning.
7. Feed calves with milk from freshest cows.
8. Continue to milk strippers and include their milk in the bulk.
9. Remove teat cups immediately after milk has been extracted.

These recommendations can be put into practice immediately. Many dairy farmers, in addition, are including a percentage of cows of the higher testing breeds in their herds and arranging for better spacing of calving. Herd testing also would lead to the elimination of inherently low testing stock.

Liquid Manure.

To make liquid manure, soak a sugar bag of fresh poultry, cow, or pig manure for a week in a cask with the head knocked in—one holding 40 to 50 gallons is the most handy. Use the resulting solution at the rate of one part to three parts of fresh water. Fill the cask again, and when the manure has soaked for a week use the solution at the rate of one part to one part of fresh water. The cask may then be filled up a third time, and after the liquid has been allowed to stand for a week it may be used neat.

This form of liquid manure is safe, and if it is applied weekly at the rate of 4 gallons to every 18 feet of a running row no further stimulant is necessary for most growing crops.

Many crops, such as lettuce, cabbage, and silver beet, will be more tender for being forced by applications of liquid manure.

GADGETS AND WRINKLES

Quarter-Twist Belt Drive.

By J. H. NICKLIN.*

OCCASIONALLY a grower who wants to install some power-driven machinery, such as an emery wheel or circular saw, finds that the layout of his engine is such that the new machine can only be placed in some position where it would be in his way, if driven by the usual belt drive from his power unit.

The quarter-twist belt drive would solve his problem in many cases by giving him further choice of sites for the new machine, and for this reason we now present particulars of this drive which is both simple and effective.

An example of the quarter-twist drive is to be seen at the Sugar Experiment Station, Mackay, where it was installed on a counter shaft which, driven by the irrigation engine, drives a small sampling mill, cane fibrator, and emery wheel. This installation permitted the three machines to be put into a small narrow shed without congesting the floor space, and has operated quite satisfactorily for more than ten years.

The important condition that must be satisfied with this type of drive is that the centre of the face of each pulley must be aligned with that face of the other pulley from which the belt leaves. When, with a vertical belt drive, a plumb line is hung over the falling side of the overhead pulley at the middle of its face, the line must touch the rising side of the lower pulley at the middle of its face.

Actually, of course, the drive need not be a quarter twist. So long as the condition mentioned is carried out the angle between the two pulleys may be anything from 0 degrees to 180 degrees.

In laying out the drive the only point to be watched is that, when looking down on the tops of the two pulleys, the arrow of direction of the top pulley must follow the arrow of direction of the lower pulley. The drawing shows the application of this rule to the four possible cases. In each case it must be understood that the belt passes over the top of the overhead pulley and thence to the far side of the pulley underneath.

Another example of this type of drive is an engine or horizontal electric motor belted to a vertical spindle pump.

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* In the *Cane Growers' Quarterly Bulletin* (Bur. Sug. Expt. Stns., Dept. Agric. & Stk., Q.) for January, 1948.

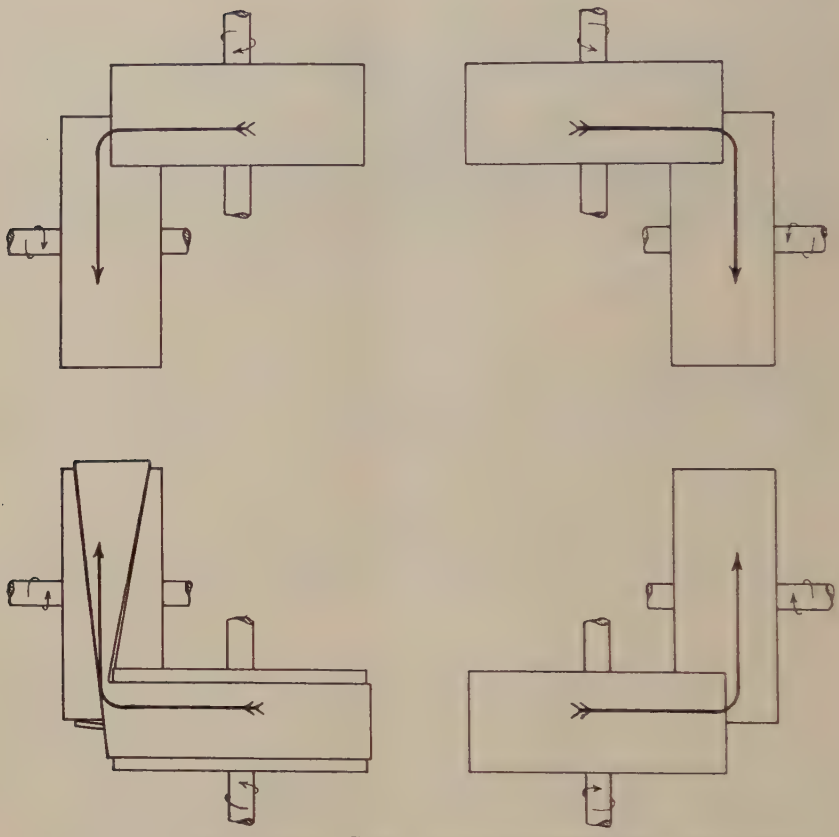

Plate 120.—FOUR POSSIBLE CASES OF THE QUARTER-TWIST BELT DRIVE.

For a satisfactory drive the following points could be kept in mind—

1. The distance between the faces of the pulleys should be at least eight times the width of the belt.
2. Thin flexible belts are desirable.
3. Pulleys of about the same diameter give best results.
4. The drive is not reversible.

A SPECIAL RADIO SERVICE FOR FARMERS

★ ★

The COUNTRY HOUR, a special service for farmers, is broadcast DAILY through the National and Regional Stations from 12.15 to 1.15 (mid-day)

Care of Mother and Child.

Under this heading an article supplied by the Maternal and Child Welfare Service of the Department of Health and Home Affairs, dealing with the welfare and care of mother and child, is published each month.

PARENTS MUST BE THE FAMILY'S HEALTH OFFICERS.

MOTHERS and fathers are in the first line of defence against their children catching infectious diseases. Governments, both State and Municipal, may supply all kinds of services by which the health of their citizens can be protected, but without the intelligent co-operation of parents it is impossible to build up a really healthy population.

Now that autumn is here and cold winter days just round the corner, we expect the usual crop of colds, whooping cough, measles and other "catching" illnesses. Shall we get together and see whether we can keep the children from becoming infected?

The first step in preventing disease is to understand what causes it. The two common types of disease among babies and young children and which cause not only a great number of deaths, but also of chronic ill health are (1) respiratory infections in which the disease germs live in the secretions of the mouth, nose, throat and air passages and are carried from person to person by coughing, sneezing, and in the case of very small children by putting their fingers in their mouths and smearing other children's hands or clothes; and (2) bowel infections in which the disease germs can be found in babies' napkins, closet pans, manure and garbage heaps or similar places and are conveyed to food by unwashed hands, or flies, cockroaches and other vermin.

Remember that disease germs are living organisms, and although they are too small to be seen without the aid of a powerful microscope they are very dangerous, especially in large numbers. They multiply very rapidly in any warm, moist medium, sometimes just by the simple process of dividing themselves in two; so that it is possible for baby's food, for instance, if carelessly handled, to grow millions of harmful germs in quite a short time.

Nature does her best to prevent us from becoming ill by providing in our blood-stream certain cells which are capable of destroying the germs of disease. Provided there are not too many of them and the body is in a healthy state, Nature's system works.

In the case of some serious infections, doctors can now assist Nature by injecting a very small number of germs which have been killed beforehand into the bloodstream and so increasing the number of our "fighting cells." This is called immunisation or inoculation, and the men and women in the armed forces during the war were all protected against disease in this way.

So parents can help to keep their children well by the following methods:—

(1) Building up the children's general resistance, so that although they may come into contact with infection they will not easily become ill. This can be done by giving the right kind of food, keeping the children in the fresh air and sunshine, and giving them plenty of rest and sleep.

(2) Keeping them away from sick people and out of crowded buildings, where there may be many people who are carrying disease germs.

(3) By having them immunised against disease where this is possible, as in the case of diphtheria, whooping cough, tetanus, &c.

(4) By keeping the house and all its surroundings clean, and keeping closet pans and rubbish tins closed. By protecting food from flies and cockroaches.

(5) By putting baby's soiled napkins into a bucket of water as soon as removed; and by always washing the hands well before handling food of any kind and after changing baby or handling a sick child.

(6) By not allowing anyone to kiss children on the mouths, and by teaching children clean habits. All the family should learn to hold a handkerchief before the mouth and nose when coughing or sneezing.

Any further advice on this and other matters about the care of children may be obtained by communicating personally with the *Maternal and Child Welfare Information Bureau*, 184 *St. Paul's Terrace, Brisbane*, or by addressing letters "*Baby Clinic, Brisbane.*" These letters need not be stamped.

IN THE FARM KITCHEN.

Cold Weather Cookery.

Potato Pastry.

Ingredients: ¼ lb. cold sieved potatoes, ¼ lb. flour, 1 teaspoon baking powder, 3 oz. butter, pinch of salt.

Cut the shortening into flour. Rub with finger tips until like fine bread crumbs. Add the baking powder and mix in potatoes. Add sufficient cold water to make a stiff dough. Roll out and use as required.

This pastry may be used for sweet or savoury dishes.

Steak and Potato Pie.

Ingredients: 8 oz. onion, ½ oz. cooking fat or dripping, 3 tablespoons flour, ¼ pint water, 1 lb. cooked stewing steak, 1 tin peas (8 oz. size), 1 to 2 teaspoons salt, ¼ teaspoon pepper, 2 lb. potatoes, cooked and mashed.

Slice the onion thinly and fry gently in the fat until tender; work in the flour. Add the water gradually and bring to the boil, stirring all the time; boil for 5 minutes. Add the steak, peas and seasoning and mix well. Place the mixture in a piedish, cover with the mashed potato and brown under the grill or in a hot oven.

Dumplings.

Ingredients: 1½ lb. mashed potato, 6 tablespoons flour, 1 egg.

Mix all ingredients together, knead the dough until smooth and pliable, and form into small oblong dumplings, dipping the hands in flour while shaping them. Drop the dumplings in boiling salted water. The dumplings are cooked when they rise to the top and float in the boiling water. Drain and serve hot.

These dumplings can be used as a sweet with syrup, fruit or jam, or with the stew.

QUEENSLAND WEATHER IN APRIL.

The patchy to very poor rainfall distribution of the first three months of the year continued during April over most of the State. A succession of moderate falls in the Peninsula districts during the first half of the month resulted in over average aggregate figures in most of those areas and flood rains over the south coast districts on the 30th brought 3 to 5-inch aggregates 29 per cent. above normal in the Moreton and 32 per cent. Port Curtis sections. The unsettled weather continued during the first two or three days of May with the beneficial rain area spreading over considerable portions of the central coast east. The rain spread inland to the Central Highlands but, although 1 to 2-inch falls were reported from several stations, benefits were too light and patchy in most localities. In the Central Lowlands very isolated falls only were registered (Muttaburra, however, registered 270 points) Far better general results, however, were recorded in the Downs and Maranoa. Many stations reported 1½ to 3 inches and over, while parts of the Warrego received moderate totals. As a result of the May rains, Downs and South Coast farming and dairying districts should commence the winter season with good cultivation and pasture conditions. Relief was also opportune in the central coast sugar lands. In the southern border pastoral districts wintering prospects should range from fair to good, mainly owing to 3 to 6-inch rains in the south-west and southern border during February. Over the central interior and tropical interior pastoral areas most districts are approaching the normally dry winter and spring with marked seasonal rainfall discrepancies. An examination of the rainfall totals for the first four months of 1948 shows the Central Highlands with 70 per cent. below normal rain, Central Lowlands 67 per cent., Upper Western 58 per cent., Lower Western 50 per cent., Lower Carpentaria 47 per cent., and Upper Carpentaria 56 per cent. During the season no general tropical rain movement penetrated through the north-west of the State, and the occasional out of season rains of this type at a very early date are now urgently required.

Floods.—Local flood and stream rise conditions commenced in the south coast on the 30th, particularly in the Mary River area, where some heavy 24-hour totals in the catchment area included 1,427 points at Miva and 10 inches at Theebine. By the 3rd May most coastal districts from the border north to Mackay had experienced traffic difficulties, &c.

Temperatures.—Mean maximum temperatures were mostly round above normal, with chief departures of 1.3 deg. below at Cairns and 1.2 deg. at Thargomindah; Georgetown and Palmerville, however, were 2.2 deg. and 3.0 deg. above respectively. Minimum temperatures were also about normal, ranging from 0.9 deg. above at Palmerville and Georgetown to 1.3 deg. below at Thargomindah.

Frosts.—The main frost period was from the 15th to the 20th and on the 24th and 25th—Kingaroy, 7 nights; Stanthorpe, 6. Grass minimum, 22 deg. on 24th at Bybera, Stanthorpe and Kingaroy, 23 deg. on 24th.

Brisbane.—Mean pressure 30.023 ins. (normal 30.038 ins.). Temperature.—Mean maximum 76.8 deg. (normal 78.8 deg.); mean minimum 59.9 deg. (normal 61.4 deg.); mean temperature 68.3 deg. (normal 70.1 deg.). Highest daily reading 86.8 deg. on 21st; lowest 51.7 deg. on 29th. Rainfall.—415 points on 12 days (average, 467 points on 12 days). Wind.—Gust westerly 50 miles per hour on 15th.

Rain position is summarised below:—

Divisions.	Normal Mean.	Mean April, 1948.	Departure from Normal.
	Points.	Points.	Per. Cent.
Peninsula North	659	930	41 above
Peninsula South	164	314	91 ,,
Lower Carpentaria	101	5	95 below
Upper Carpentaria	115	..	100 ,,
North Coast, Barron	788	256	68 ,,
North Coast, Herbert	822	325	60 ,,
Central Coast, East	288	160	44 ,,
Central Coast, West	145	25	83 ,,
Central Highlands	150	30	80 ,,
Central Lowlands	121	2	98 ,,
Upper Western	57	..	100 ,,
Lower Western	80	..	100 ,,
South Coast, Port Curtis	249	329	32 above
South Coast, Moreton	416	535	29 ,,
Darling Downs, East	161	77	52 below
Darling Downs, West	119	87	27 ,,
Maranoa	129	22	83 ,,
Warrego	110	20	82 ,,
Far South-West	86	..	100 ,,

Commonwealth of Australia, Meteorological Bureau, Brisbane.

ASTRONOMICAL DATA FOR QUEENSLAND.

JUNE.

Supplied by W. J. NEWELL, Hon. Secretary of the Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			MINUTES LATER THAN BRISBANE AT OTHER PLACES.					
Date.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	6.30	5.00	Cairns	8	50	Longreach	26	43
6	6.32	5.00	Charleville	25	29	Quilpie	37	33
11	6.34	4.59	Cloncurry	36	63	Rockhampton ..	1	19
16	6.36	5.00	Cunnamulla ..	31	27	Roma	15	19
21	6.38	5.00	Dirranbandi ..	22	16	Townsville	8	42
26	6.39	5.2	Emerald	11	28	Winton	29	52
30	6.39	5.3	Hughenden ..	21	49	Warwick	5	3

TIMES OF MOONRISE AND MOONSET.

At Brisbane.		
Date.	Rise.	Set.
	a.m.	p.m.
1	12.12	1.05
2	1.05	1.33
3	1.59	2.02
4	2.54	2.33
5	3.53	3.08
6	4.54	3.47
7	5.59	4.34
8	7.06	5.29
9	8.11	6.31
10	9.12	7.39
11	10.05	8.48
12	10.52	9.56
13	11.32	11.02
	p.m.	
14	12.08	..
		a.m.
15	12.42	12.05
16	1.14	1.07
17	1.48	2.08
18	2.24	3.09
19	3.03	4.11
20	3.47	5.12
21	4.35	6.12
22	5.28	7.09
23	6.23	8.02
24	7.19	8.48
25	8.16	9.28
26	9.11	10.04
27	10.04	10.36
28	10.56	11.05
29	11.49	11.34
		p.m.
30	..	12.02

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

Charleville 27; Cunnamulla 29; Dirranbandi 19;
Quilpie 35; Roma 17; Warwick 4.

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Date.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	23	17	39	32	14	8	44	37
6	13	27	28	43	2	18	31	51
11	11	28	26	43	0	19	28	51
16	21	15	38	31	12	7	43	35
21	30	9	46	24	21	0	53	26
26	25	13	42	28	16	3	48	31
30	17	20	32	36	8	11	21	42

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Date.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	37	24	55	46	40	31	31	21
3	28	33	50	54	34	38	24	29
5	17	43	41	59	26	45	15	36
7	8	52	36	65	21	50	8	44
9	3	55	34	67	18	52	4	45
11	7	49	36	63	20	49	7	41
13	18	38	42	57	27	42	16	33
15	28	27	50	48	34	33	24	23
17	40	15	57	41	42	26	33	14
19	48	6	63	34	48	20	40	7
21	55	3	68	32	51	18	45	4
23	54	5	67	34	51	20	44	6
25	43	12	60	38	45	24	36	12
27	39	17	56	42	41	27	33	16
29	30	26	51	47	35	33	25	22
30	24	31	46	52	31	37	21	27

Phases of the Moon.—New Moon, June 7th, 10.55 p.m.; First Quarter, June 14th, 3.40 p.m.; Full Moon, June 21, 10.54 p.m.; Last Quarter, June 30th, 1.23 a.m.

On June 21st, at 10 p.m., the Sun will reach its greatest angle north of the equator and will then rise 26 degrees north of east and set 26 degrees north of west.

Mercury.—At the beginning of the month will be an evening object and will set about 1 hour and a-quarter after the Sun. It will reach inferior conjunction with the Sun on June 24th, after which it will pass into the morning sky, and by the end of the month will rise ¾ hour before the Sun.

Venus.—Will be visible low in the west during evening twilight at the beginning of June, when it will set 2 hours after the Sun, but by the 24th it will be in line with the Sun and will then pass into the morning sky. At the end of the month it will rise about ¾ hour before the sunrise.

Mars.—Still in the constellation of Leo, at the beginning of June will set at midnight, and by the 30th will set from 10.45 p.m. in south-east Queensland to midnight in western Queensland.

Jupiter.—In the constellation of Ophiuchus, will be opposite the Sun on the 15th, and consequently this month Jupiter will be visible all night, rising at sunset and setting near sunrise.

Saturn.—In the constellation of Leo, on the 1st will set between 9.45 p.m. and 11 p.m., and by the 30th will set between 8.15 p.m. and 9.15 p.m.

Star Charts.—The chart on the right is for 7.15 p.m. in the south-east corner of Queensland to 8.15 p.m. along the Northern Territory border on the 15th June. (For every degree of longitude we go west the time increases 4 minutes.) The chart on the left is for 10 hours later. On each chart the dashed circle is the horizon as viewed from Cape York, and the dotted circle is the horizon for places along the N.S.W. border. When facing north hold "N" at the bottom; when facing south hold "S" at the bottom, and similarly for the other directions. Only the brightest stars are included and the more conspicuous constellations named. The stars which do not change their relation to one another, moving east to west, arrive at any selected position about 4 minutes earlier each night. Thus, at the beginning of the month the stars will be in the positions shown about 1 hour later than the time stated for the 15th and at the end of the month about 1 hour earlier than that time. The positions of the moon and planets, which are continually changing in relation to the stars, are shown for certain marked days. When no date is marked the position is for the middle of the month.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

APRIL RAINFALL.

(Compiled from Telegraphic Reports.)

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	April.	No. of years' records.	April, 1947.	April, 1948.		April.	No. of years' records.	April, 1947.	April, 1948.
North Coast.	In.		In.	In.	*South Coast—contd.*	In.		In.	In.
Atherton	4·42	42	2·00	3·19	Caboolture	4·48	67	2·94	4·83
Cairns	11·23	61	4·42	3·10	Childers	2·85	48	3·74	3·65
Cardwell	8·78	71	1·46	2·49	Crohamhurst	6·68	50	5·18	9·69
Cooktown	8·69	67	0·93	2·71	Esk	2·89	56	2·06	3·00
Herberton	3·73	57	0·87	1·86	Gatton College	1·86	44	1·70	1·65
Ingham	7·64	51	0·68	3·55	Gayndah	1·46	72	5·42	3·22
Innisfail	20·21	62	4·16	10·04	Gympie	3·43	73	4·66	7·81
Mossman	7·41	19	3·41	5·07	Kilkivan	2·20	62	4·44	6·03
Townsville	3·29	72	0·01	0·19	Maryborough	3·81	72	6·75	4·81
Central Coast.					Nambour	6·13	47	6·21	8·32
Ayr	2·77	56	..	1·03	Nanango	1·93	61	3·45	1·40
Bowen	2·91	72	0·29	2·07	Rockhampton	2·53	72	0·44	2·37
Charters Towers	1·54	61	..	..	Woodford	4·52	55	2·32	7·26
Mackay	6·31	72	0.99	2·53	*Darling Downs.*				
Proserpine	6·11	40	1·21	6·33	Dalby	1·39	73	0·88	0·41
St. Lawrence	2·73	72	0·79	1·82	Emu Vale	1·32	47	2·18	0·38
Central Highlands.					Jimbour	1·42	64	1·48	0·52
Clermont	1·64	47	..	..	Miles	1·43	58	0·35	1·04
Springsure	1·56	74	0·21	0·55	Stanthorpe	1·70	70	3·35	0·65
South Coast.					Toowoomba	2·56	71	2·11	1·70
Biggenden	2·15	44	5·16	3·17	Warwick	1·60	78	1·64	0·47
Bundaberg	3·25	60	1·99	5·28	*Maranoa.*				
Brisbane Bureau	3·71	95	6·54	4·15	Roma	1·28	69	..	0·20
					St. George	1·29	62	0·42	0·15

CLIMATOLOGICAL DATA FOR APRIL.

(Compiled from Telegraphic Reports.)

Divisions and Stations.	Atmospheric Pressure Mean at 9 a.m.	Shade Temperature.		Extremes of Shade Temperature.				Rainfall.	
		Mean Max.	Mean Min.	Max.	Date.	Min.	Date.	Total.	Wet Days.
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Pts.	
Cairns	..	84	71	89	7	64	24	310	15
Herberton	..	78	60	87	22	47	24	186	12
Townsville	..	85	69	91	15	59	25	19	3
Rockhampton	30·03	83	61	93	21, 22	46	16	237	6
Brisbane	30·07	77	60	87	21	52	20	415	12
Darling Downs.									
Dalby	..	78	51	88	21	34	24	41	4
Stanthorpe	..	68	45	79	20	26	24	65	5
Toowoomba	..	72	50	82	21	33	24	170	9
Mid-Interior.									
Georgetown	29·93	92	67	97	25	52	24	..	..
Longreach	30·04	88	61	99	2	46	16, 24, 25	..	..
Mitchell	30·05	80	51	91	20	34	24	3	1
Western.									
Burketown	..	91	67	97	22	55	24	..	..
Boulia	29·97	88	62	101	2	49	16	..	..
Thargomindah	30·04	81	57	94	2, 1	45	26	..	..

A. S. RICHARDS,
Deputy Director, Meteorological Services.

Commonwealth of Australia,
Meteorological Bureau, Brisbane